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# FLOOD INSURANCE STUDY

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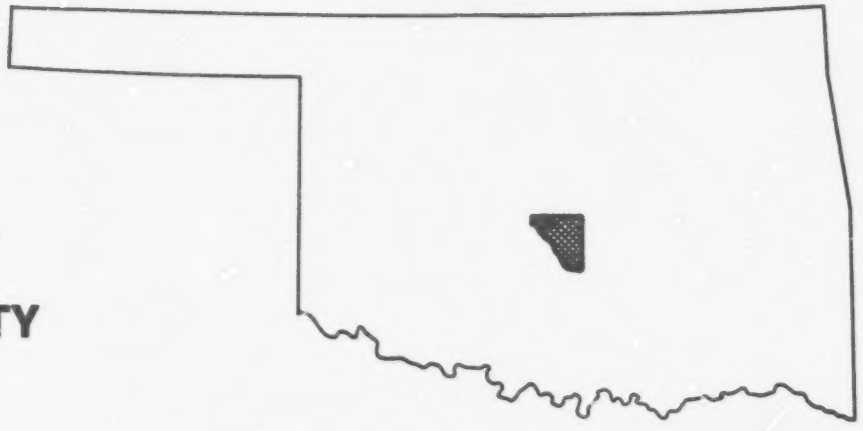

## CITY OF MOORE, OKLAHOMA
### CLEVELAND COUNTY

FEBRUARY 19, 1986

ORIGINAL

Federal Emergency Management Agency

COMMUNITY NUMBER - 400044

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NOTICE TO
FLOOD INSURANCE STUDY USERS

This Flood Insurance Study was revised on February 19, 1986. Users should refer to the Revision Description section (Section 9.0) of this text for further information.

Part or all of this Flood Insurance Study may be revised at any time. The user is therefore cautioned that a published map revision (i.e., a revised Flood Insurance Rate Map) may not include a reprinting of the text, tables, and/or profiles, resulting in a discrepancy between the revised map and the original study components. It is the responsibility of the user to consult with community officials to obtain the most current Flood Insurance Study components.

Initial Flood Insurance Study Effective Date: 12/02/80

Flood Insurance Study Revised: 07/05/84
02/19/86

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Flood Boundary and Floodway Map

PUBLISHED SEPARATELY:

Flood Insurance Rate Map Index
Flood Insurance Rate Map




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FLOOD INSURANCE STUDY
CITY OF MOORE, OKLAHOMA

## 1.0 INTRODUCTION

### 1.1 Purpose of Study

This Flood Insurance Study investigates the existence and severity of flood hazards in the City of Moore, Cleveland County, Oklahoma, and aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. This study has developed flood risk data for various areas of the community that will be used to establish actuarial flood insurance rates and assist the community in their efforts to promote sound flood plain management. Minimum flood plain management requirements for participation in the National Flood Insurance Program are set forth in the Code of Federal Regulations at 44 CFR, 60.3.

In some states or communities, flood plain management criteria or regulations may exist that are more restrictive or comprehensive than the minimum Federal requirements. In such cases, the more restrictive criteria take precedence and the state (or other jurisdictional agency) will be able to explain them.

### 1.2 Authority and Acknowledgments

The sources of authority for this Flood Insurance Study are the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

The hydrologic and hydraulic analyses for this study were prepared by Benham-Blair & Associates, Inc., for the Federal Emergency Management Agency, under Contract No. H-4642. This work was completed in June 1979. The updated hydraulic analysis for the North Fork River was prepared by Phillips, Stong, and Coon, under agreement with the Federal Emergency Management Agency. The updated work was completed August 1983. The approximate study performed on Stream E was also revised on the basis of data submitted in a LOMA request by Dodson-Roberts Surveying.

### 1.3 Coordination

On March 15, 1978, the nature and purpose of the study were explained, corporate boundaries were delineated, and streams requiring detailed and approximate study were identified at an initial Consultation and Coordination Officer's (CCO) meeting attended by representatives of FEMA, the City of Moore, and Benham-Blair & Affiliates, Inc. (the original study contractor). An announcement was placed in the local newspaper at

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the beginning of the study stating its objectives and designating a city official that should be contacted for those having information pertinent to the study. On January 7, 1980, the results of the study were reviewed at a final CCO meeting held with representatives of FEMA, the city, and the study contractor.

## 2.0 AREA STUDIED

### 2.1 Scope of Study

This Flood Insurance Study covers the incorporated area of the City of Moore, Cleveland County, Oklahoma. The area of study is shown on the Vicinity Map (Figure 1).

The North Fork River was studied by detailed methods from a point approximately 4,000 feet south of Southeast 34th Street and 1,800 feet east of State Highway 77H to a point approximately 2,600 feet north of Northeast 12th Street and 1,900 feet east of Eastern Avenue. The revised hydraulic analysis was performed on the North Fork River from a point just upstream of Bryant Avenue to a point just downstream of NE 12th Street. This analysis accounted for a channelization project done as a part of the construction of Mashburn's Gold Medal addition. Several unnamed tributaries to the North Fork River were also studied in detail. These streams are labeled as Streams A, B, C, and D.

Stream A was studied by detailed methods from its confluence with the North Fork River to a point approximately 700 feet north of Southest 34th Street and 3,000 feet east of State Highway 77H. Stream B was studied from its confluence with the North Fork River to a point northwest of the intersection of Southeast 19th Street and State Highway 77H. Stream C was studied in detail from its confluence with the North Fork River to a point on the northern corporate limits 0.5 mile north of Northeast 12th Street and 0.5 mile east of Bryant Avenue. Stream D was studied from its confluence with the North Fork River to a point approximately 2,000 feet north of Southeast 19th Street and 1,800 feet east of Eastern Avenue.

The Little River was also studied by detailed methods from a point on the southern corporate limits approximately 1,600 feet east of Interstate Highway 35 to a point approximately 800 feet north of Northeast 19th Street and 1,600 feet east of Interstate Highway 35. An unnamed tributary to the Little River, labeled as Stream E, was studied in detail from a point approximately 800 feet south of Southwest 34th Street and 3,200 feet west of Interstate Highway 35 to a point approximately 3,300 feet north of Southwest 34th Street and 4,800 feet west of Interstate Highway 35. The areas studied by detailed methods were selected with priority given to all known flood hazard areas and areas of projected development and proposed construction.



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FEDERAL EMERGENCY MANAGEMENT AGENCY

# CITY OF MOORE, OK

(CLEVELAND CO.)

APPROXIMATE SCALE

8 0 8 16 24 MILES

## VICINITY MAP

FIGURE 1

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Stream E was studied by approximate methods from the southern corporate limits 1,900 feet west of Interstate Highway 35 to the beginning of the detailed study. The most upstream portion of the approximate study on Stream E was revised to reflect a Letter of Map Amendment that determined the area was not affected by flooding. Approximate analyses were used to study those areas having a low development potential or minimal flood hazards. The scope and methods of study were proposed to, and agreed upon by, FEMA and the City of Moore.

## 2.2 Community Description

The City of Moore is located in the northern portion of Cleveland County in central Oklahoma, immediately south of the City of Oklahoma City. The total land area contained within the corporate limits of Moore is approximately 22.3 square miles. The population of the city in 1970 was 18,761; the present population is estimated at 32,500. The main transportation routes through the city are State Highways 77H and 77 and Interstate Highway 35. Moore is also served by the Atchison, Topeka, and Santa Fe Railway.

Approximately 50 percent of the incorporated area is developed, with the remainder of the land in open pasture and grasslands. Portions of the southeastern and southwestern corporate limits contain land that is under cultivation. Most of the development is located in the central, west-central, and northwestern portions of the city. The development consists mainly of light-to-heavy commercial and residential areas. The main areas of residential growth are in the eastern and southeastern portions of Moore. Industrial growth is minimal at the present time.

Development within the flood plains studied is minimal. There are several homes and trailers within the flood plain of Stream A. There are several salvage yards, a trailer park, several single-family residences, and several light businesses within the flood plain of the Little River. Development within the flood plains of the remaining streams consists mainly of roads and streets.

The climate of Oklahoma is generally continental, as in all of the Central Great Plains. The average winter temperatures in Moore range from a low of 30 degrees Fahrenheit (°F) to a high of 49°F. The average summer temperatures range from a low of 70°F to a high of 91°F. The average annual precipitation is approximately 33 inches.

The North Fork River is located in the eastern portion of Moore and flows generally south to the confluence with the Little River. The topography of the North Fork River basin is moderately rolling. Within the corporate limits, the river has a drainage area of approximately 15 square miles, with an average basin slope of approximately 28 feet per mile. The majority of the development in the basin within Moore consists of medium-density residential and light- and medium-density commercial



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areas. The remainder of the basin is mainly open pasture and rangeland. The majority of the soils found in the basin upland areas is the Kirkland silt loam and the Renfrow silt loam, which generally drain slowly. Lowlands are occupied by the Yahola silt loam and the Vernon clay loam. The Yahola silt loam is moderately well drained and found in the flood plains, while the Vernon clay loam is slowly drained and found adjacent to the streams.

Stream A is located in the southeastern portion of the city and flows south to its confluence with the North Fork River. The majority of the area near the stream is undeveloped, with only light-density residential development sparsely located on rangeland and pasture. The total drainage area is 1.4 square miles, and the basin slope averages 55 feet per mile.

Stream B, located in the southeastern portion of Moore, is also a tributary of the North Fork River and flows south. Most of the land near the stream is rangeland and pasture, with a few scattered light residential areas. Stream B has a total drainage area of 1.4 square miles and an average slope of 50 feet per mile.

Stream C is located in the east-central portion of the city and flows south to its confluence with the North Fork River. The drainage basin of the stream consists mostly of open rangeland and pasture, with a few single-family residences. Stream C has a drainage area of 3.3 square miles and an average basin slope of 31 feet per mile.

Stream D flows southeast to its confluence with the North Fork River. The upper portion of the stream basin contains several medium- and high-density residential developments, while the lower portion is mainly undeveloped rangeland and pasture. The drainage area of Stream D is 2.4 square miles; the average basin slope is 32 feet per mile.

The Little River is located in the central portion of Moore and flows south through the city. The topography of the basin is moderately rolling. The soils of the Little River basin are very similar to those found in the North Fork River basin. One additional soil type prevalent in the uplands of the Little River basin is the Bethany silt loam, which is generally very slowly drained.

Within the study area, the Little River has a drainage area of 8.7 square miles and an average basin slope of 34.5 feet per mile. The majority of the development within the Little River basin is located north of South 19th Street. The development consists of medium- and light-density commercial areas in the central business district, and numerous high- and



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medium-density residential areas both north and south of the central business district. Most of the development south of South 19th Street is light-commercial along Interstate Highway 35. The remainder of the basin is mainly undeveloped pasture and rangeland.

Stream E is located in the southwestern portion of Moore and flows southeast to its confluence with the Little River. The majority of the development in the Stream E basin is located north of South 19th Street and consists mainly of medium- and heavy-density single-family residences and light-density commercial areas along Southwest 4th Street. The remainder of the basin is undeveloped pasture, except for minor commercial development along Interstate Highway 35. The drainage area of Stream E is 3 square miles, and the average basin slope is 24 feet per mile.

## 2.3 Principal Flood Problems

Limited flood data were available for Moore, since there are no gages on the streams within the study area. The history of flooding within the city was obtained from local newspaper accounts and local residents. Flooding in this part of Oklahoma occurs during the spring and fall and is associated with heavy thunderstorms and tornadoes. A major storm occurred on September 22, 1970. According to the local newspaper, 9.51 inches of rain fell in a 24-hour period, with 3.4 inches occurring in a two-hour period. The total rainfall of this storm approximated a 100-year 24-hour storm; however, the two-hour precipitation is considerably less than the intensity expected in a 100-year storm, making the assignment of a frequency to this storm very difficult. The following excerpt from The Norman Transcript describes the storm (Reference 1).

> "Moore was apparently the hardest hit as more than 5 inches of rain this morning flooded streets and low-lying areas. Moore police and fire department personnel reported at least 25 persons rescued from stranded autos."
>
> "Ten more were moved out of their homes in the vicinity of 1st Street and Irving."
>
> "...Moore had received only 1.60 inches of rain by 7 A.M. today, but by 9 A.M. the total had risen to five inches."

The Moore Monitor had the following account of the storm (Reference 2):

> "A 9.51-inch rain fell on Moore during a 24-hour period this week, resulting in dozens of stranded motorists and the evacuation of at least one family by the Moore Fire Department.



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"...several houses in the area of 1st Street and Irving were flooded. Moore received only 1.60 inches of rain by 7 A.M. Tuesday, but by 9 A.M. the total had risen to five inches. Almost five more inches fell before 7 A.M. Wednesday."

Other events of a smaller magnitude occurred in Moore in May 1957, June 1957, May 1967, and May 1977. However, no information was found concerning these storms other than information from residents.

Several hydraulic structures along streams in the study area became inundated by backwater effects and consequently are submerged obstructions to flow. Structures with some degree of siltation that would affect flow-carrying capacity are the Southeast 19th Street structure on Stream B and the Southwest 34th Street structure on Stream E. Structures that are considered constrictive are the U. S. Highway 77 and the East Hills Drive structures on the North Fork River, and the Southeast 34th Street structure on Stream A.

Figures 2 through 10 show potential 100- and 500-year flood heights at various locations within the City of Moore.

## 2.4 Flood Protection Measures

Accelerated residential growth has occurred in Moore in the last several years. Along with this expansion of the residential area, channel improvements have been made in connection with this construction; however, there are no known planned or existing dams or floodwater-retarding structures on streams in the study area. Lake Thunderbird, located southeast of Moore, regulates flow in the Little River; however, within the study limits, the Little River is unaffected by this reservoir.

# 3.0 ENGINEERING METHODS

For the flooding sources studied in detail in the community, standard hydrologic and hydraulic study methods were used to determine the flood hazard data required for this study. Flood events of a magnitude which are expected to be equaled or exceeded once on the average during any 10-, 50-, 100-, or 500-year period (recurrence interval) have been selected as having special significance for flood plain management and for flood insurance rates. These events, commonly termed the 10-, 50-, 100-, and 500-year floods, have a 10, 2, 1, and 0.2 percent chance, respectively, of being equaled or exceeded during any year. Although the recurrence interval represents the long term average period between floods of a specific magnitude, rare floods could occur at short intervals or even within the same year. The risk of experiencing a rare flood increases when periods greater than 1 year are considered. For example,



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FIGURE 2: Bridge at N.E. 12th Street on Stream C.

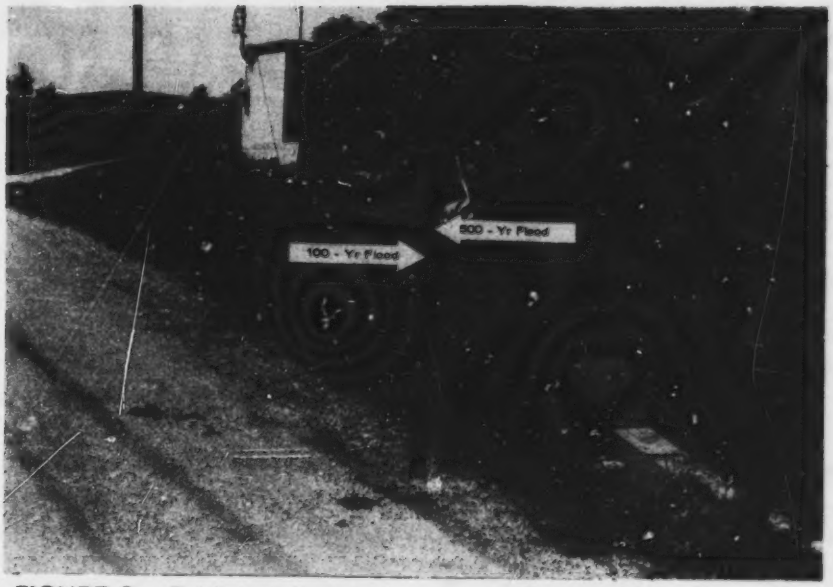


FIGURE 3: Bridge at Bryant Avenue on Stream D.

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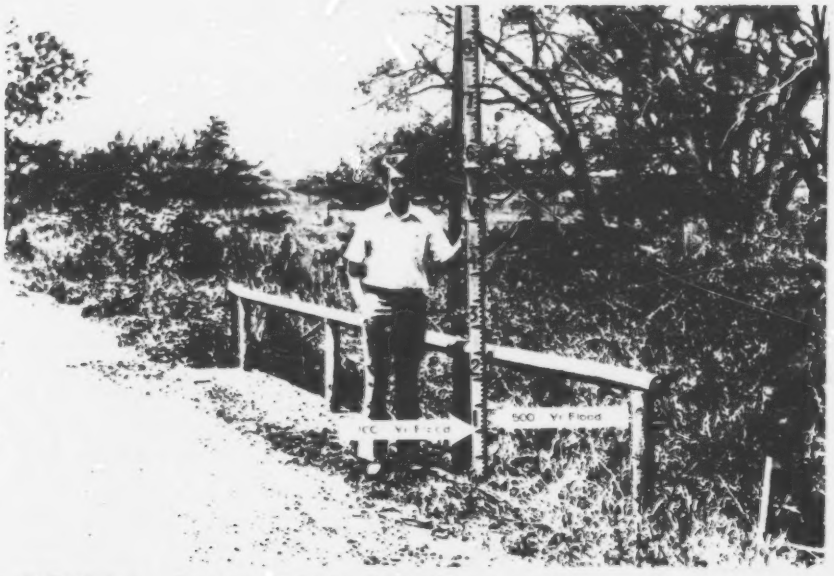

FIGURE 4: Bridge at S.W. 34th Street on Stream E.

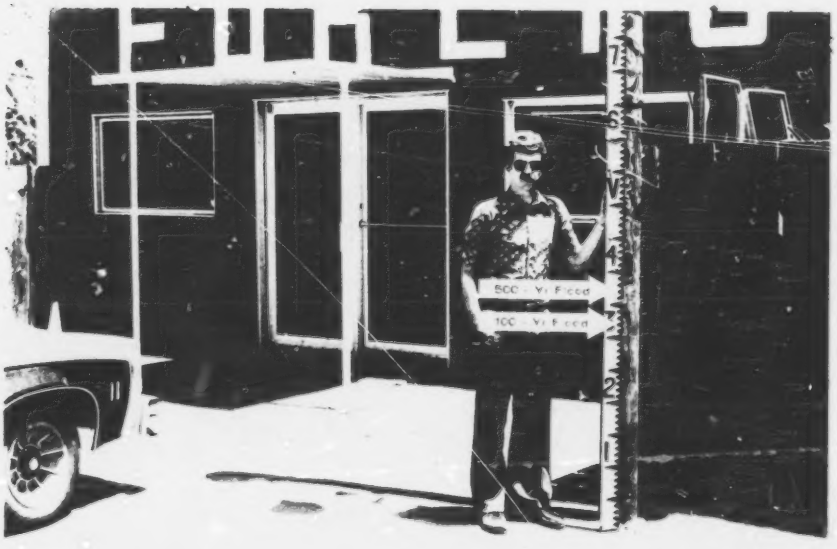

FIGURE 5: Downstream from bridge at S.W. 34th Street on Little River.

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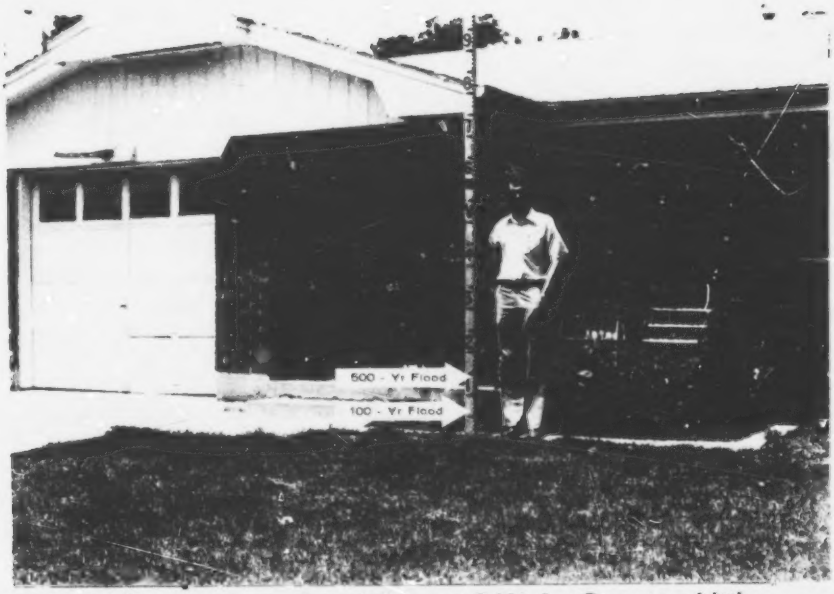


FIGURE 6: Upstream from bridge at S.W. 1st Street on Little River.

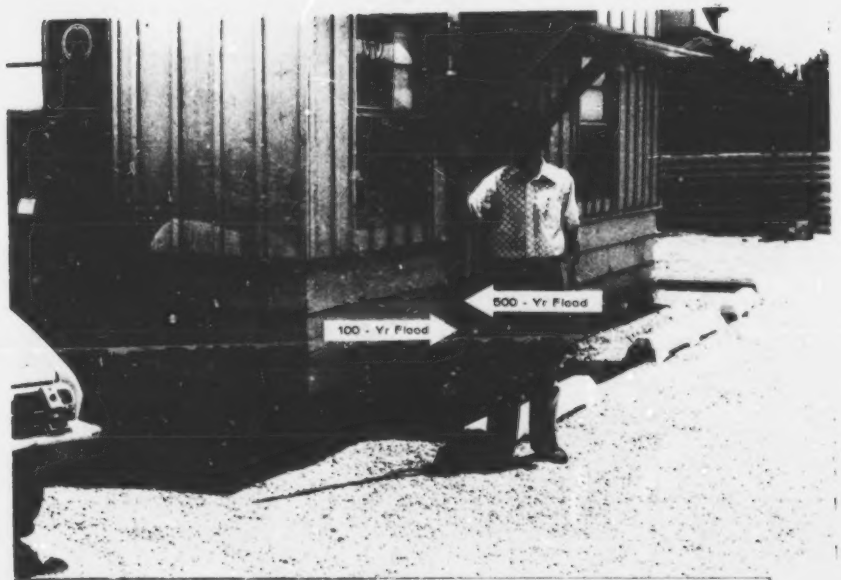


FIGURE 7: Downstream from bridge at N. 12th Street on Little River.

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FIGURE 8: Upstream from Sooner Drive on Stream A.

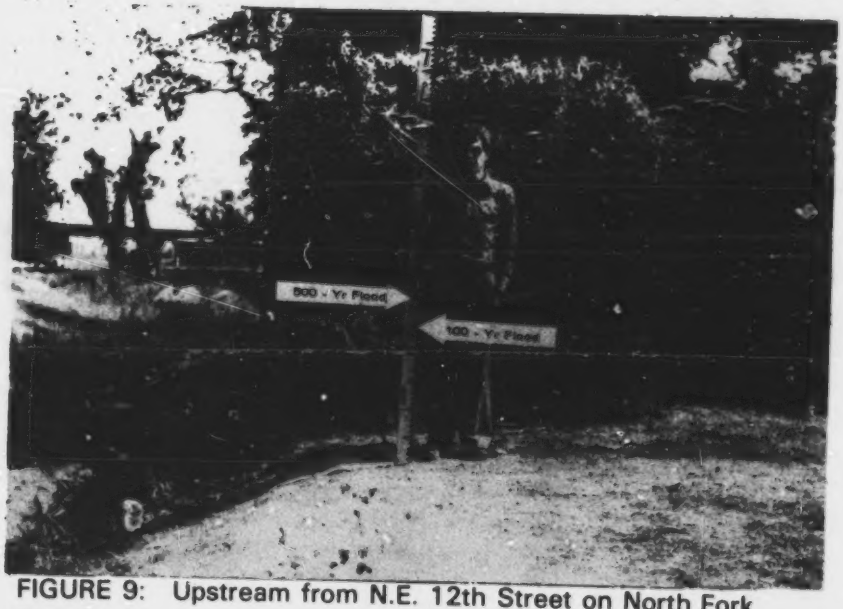


FIGURE 9: Upstream from N.E. 12th Street on North Fork River.

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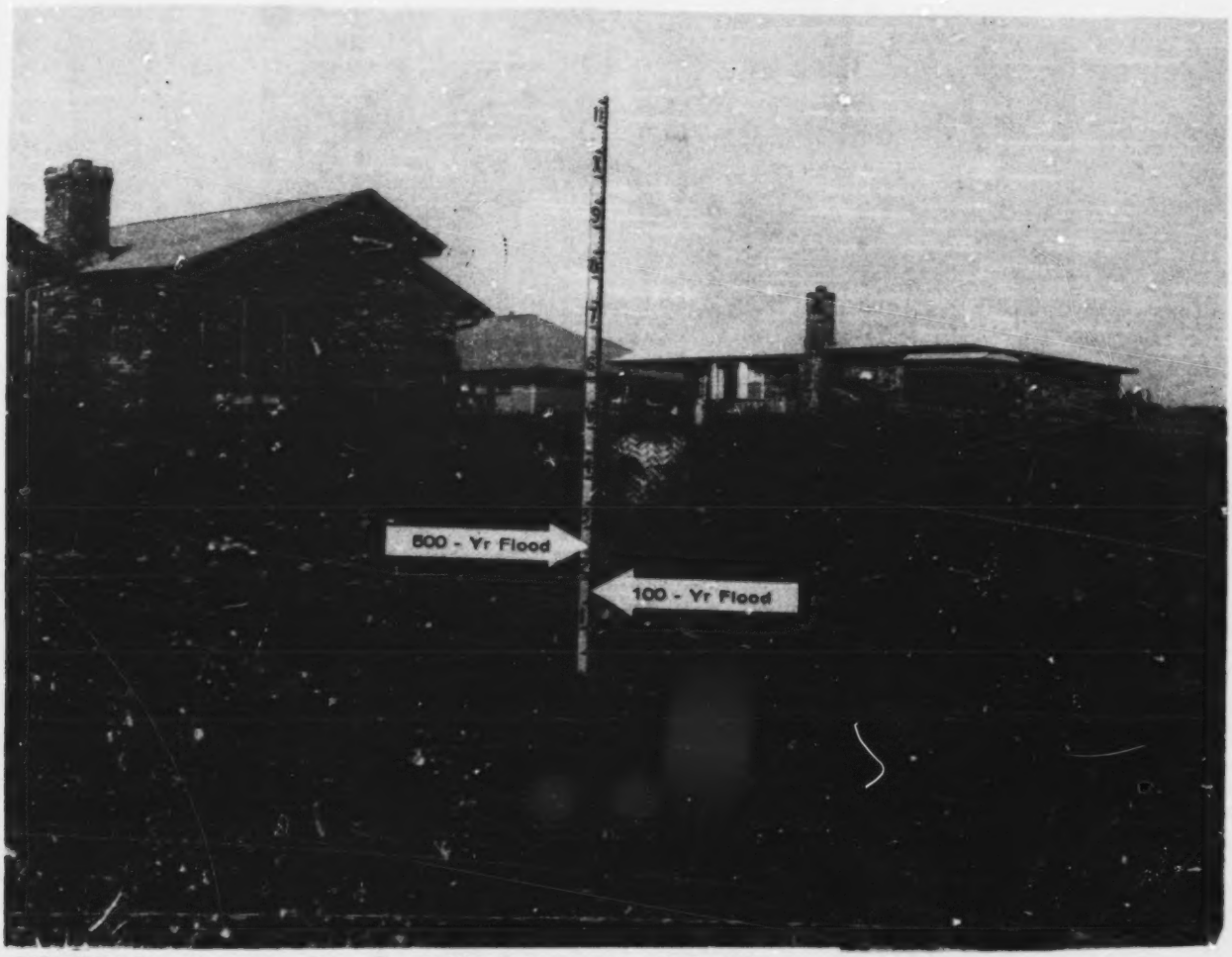


FIGURE 10: Upstream from East Hills Drive on North Fork River.

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the risk of having a flood which equals or exceeds the 100-year flood (1 percent chance of annual exceedence) in any 50-year period is approximately 40 percent (4 in 10), and, for any 90-year period, the risk increases to approximately 60 percent (6 in 10). The analyses reported herein reflect flooding potentials based on conditions existing in the community at the time of completion of this study. Maps and flood elevations will be amended periodically to reflect future changes.

3.1 Hydrologic Analyses

Hydrologic analyses were carried out to establish the peak discharge-frequency relationships for each flooding source studied in detail affecting the community.

For the streams studied by detailed methods, discharges were developed for the selected recurrence intervals from the methodology contained in the U. S. Geological Survey (USGS) Water Resources Investigation 77-54 (Reference 3). This procedure involves the computation of discharges through regression equations developed by the USGS. The peak flow rates are based on drainage area, basin slope, mean annual precipitation, and urbanization.

A summary of drainage area-peak discharge relationships for the streams studied by detailed methods is shown in Table 1, "Summary of Discharges."

TABLE 1 - SUMMARY OF DISCHARGES

| FLOODING SOURCE AND LOCATION | DRAINAGE AREA (sq. miles) | PEAK DISCHARGES (cfs) 10-YEAR | 50-YEAR | 100-YEAR | 500-YEAR |
|---|---|---|---|---|---|
| NORTH FORK RIVER | | | | | |
| At the confluence of Stream A | 14.93 | 3,610 | 6,190 | 7,640 | 11,165 |
| At a point approximately 1,200 feet upstream of the confluence of Stream A | 13.51 | 3,375 | 5,780 | 7,125 | 10,405 |
| At a point approximately 1,220 feet upstream of the confluence of Stream B | 10.51 | 2,980 | 5,120 | 6,305 | 9,200 |
| At a point approximately 100 feet upstream of the confluence of Stream D | 7.70 | 2,420 | 4,150 | 5,100 | 7,425 |



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TABLE 1 - SUMMARY OF DISCHARGES - continued

| FLOODING SOURCE AND LOCATION | DRAINAGE AREA (sq. miles) | PEAK DISCHARGES (cfs) 10-YEAR | 50-YEAR | 100-YEAR | 500-YEAR |
|---|---|---|---|---|---|
| NORTH FORK RIVER (continued) | | | | | |
| At a point approximately 200 feet upstream of the confluence of Stream C | 3.81 | 1,700 | 2,830 | 3,435 | 4,905 |
| At a point approximately 1,200 feet upstream of Southeast 4th Street | 3.08 | 1,410 | 2,370 | 2,875 | 4,125 |
| At a point approximately 2,165 feet downstream of Northeast 12th Street | 1.98 | 1.045 | 1,775 | 2,160 | 3,110 |
| STREAM A | | | | | |
| At its confluence with the North Fork River | 1.42 | 795 | 1,425 | 1,755 | 2,585 |
| At a point upstream of Southeast 34th Street | 1.08 | 700 | 1,255 | 1,550 | 2,280 |
| STREAM B | | | | | |
| At its confluence with the North Fork River | 1.37 | 745 | 1,335 | 1,645 | 2,515 |
| At a point downstream of Southeast 19th Street | 1.17 | 720 | 1,290 | 1,590 | 2,340 |
| At a point approximately 1,385 feet upstream of Southeast 19th Street | 1.00 | 660 | 1,190 | 1,465 | 2,165 |
| STREAM C | | | | | |
| At its confluence with the North Fork River | 3.32 | 1,300 | 2,280 | 2,810 | 4,115 |
| At a point downstream of Southeast 4th Street | 2.61 | 1,120 | 1,960 | 2,410 | 3,530 |
| At a point approximately 2,870 feet upstream of Southeast 4th Street | 2.35 | 1,060 | 1,860 | 2,285 | 3,340 |
| At a point approximately 1,250 feet downstream of Northeast 12th Street | 2.14 | 985 | 1,725 | 2,115 | 3,090 |
| At a point approximately 1,480 feet upstream of Northeast 12th Street | 1.62 | 830 | 1,450 | 1,775 | 2,590 |

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TABLE 1 - SUMMARY OF DISCHARGES - continued

| FLOODING SOURCE AND LOCATION | DRAINAGE AREA (sq. miles) | PEAK DISCHARGES (cfs) 10-YEAR | 50-YEAR | 100-YEAR | 500-YEAR |
|---|---|---|---|---|---|
| STREAM D | | | | | |
| At its confluence with the North Fork River | 2.44 | 1,160 | 1,970 | 2,395 | 3,455 |
| At a point approximately 1,215 feet downstream of Bryant Avenue | 2.27 | 1,155 | 1,940 | 2,350 | 3,360 |
| At a point approximately 1,715 feet upstream of Bryant Avenue | 2.10 | 1,105 | 1,855 | 2,245 | 3,210 |
| At a point immediately south of Southeast 19th Street | 1.60 | 960 | 1,585 | 1,910 | 2,710 |
| At a point approximately 1,360 feet upstream of Southeast 19th Street | 1.34 | 885 | 1,445 | 1,735 | 2,438 |
| At a point approximately 4,325 feet upstream of Southeast 19th Street | 1.03 | 805 | 1,300 | 1,550 | 2,165 |
| LITTLE RIVER | | | | | |
| Downstream of the confluence of Stream E | 8.70 | 2,590 | 4,355 | 5,320 | 7,680 |
| At a point near the south end of the Morre WWTP | 4.72 | 1,905 | 3,115 | 3,755 | 5,330 |
| At a point approximately 1,300 feet upstream of South 34th Street | 4.24 | 1,870 | 3,030 | 3,640 | 5,132 |
| At a point approximately 70 feet downstream of Telephone Road | 3.00 | 1,619 | 2,568 | 3,058 | 4,254 |
| At a point approximately 1,350 feet upstream of Southwest 17th Street | 2.81 | 1,577 | 2,508 | 2,989 | 4,161 |
| At a point approximately 910 feet downstream of Southwest 4th Street | 2.33 | 1,554 | 2,489 | 2,971 | 4,145 |
| At a point approximately 70 feet downstream of Telephone Road | 1.57 | 1,124 | 1,808 | 2,158 | 3,013 |
| At a point approximately 150 feet upstream of Telephone Road | 1.42 | 1,036 | 1,686 | 2,019 | 2,835 |



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TABLE 1 - SUMMARY OF DISCHARGES - continued

| FLOODING SOURCE AND LOCATION | DRAINAGE AREA (sq. miles) | PEAK DISCHARGES (cfs) 10-YEAR | 50-YEAR | 100-YEAR | 500-YEAR |
|---|---|---|---|---|---|
| LITTLE RIVER | | | | | |
| At a point approximately 80 feet downstream of Broadway | 1.18 | 913 | 1,497 | 1,794 | 2,525 |
| At a point approximately 75 feet downstream of North 12th Street | 1.09 | 852 | 1,402 | 1,681 | 2,370 |
| STREAM E | | | | | |
| At a point approximately 1,275 feet downstream of Southwest 34th Street | 3.03 | 1,216 | 2,051 | 2,493 | 3,586 |
| At a point approximately 75 feet downstream of Southwest 34th Street | 2.54 | 1,056 | 1,780 | 2,160 | 3,100 |
| At a point approximately 1,125 feet upstream of Southwest 34th Street | 2.19 | 1,002 | 1,689 | 2,049 | 2,941 |
| At a point approximately 1,975 feet upstream of Southwest 34th Street | 1.76 | 931 | 1,551 | 1,872 | 2,667 |
| At a point approximately 2,985 feet upstream of Southwest 34th Street | 1.33 | 792 | 1,320 | 1,590 | 2,263 |

### 3.2 Hydraulic Analyses

Analyses of the hydraulic characteristics of flooding from the sources studied were carried out to provide estimates of the elevations of floods of the selected recurrence intervals.

Valley cross sections and roadway sections were obtained from field surveys. All bridges and culverts were field surveyed to obtain elevation data and structural geometry.

Locations of selected cross sections used in the hydraulic analyses are shown on the Flood Profiles (Exhibit 1). For stream segments for which a floodway was computed (Section 4.2), selected cross section locations are also shown on the Flood Boundary and Floodway Map (Exhibit 2).



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Channel roughness coefficients (Manning's "n") used in the hydraulic computations were assigned during the field reconnaissance and were based on engineering judgment and methodology described in two publications (References 4 and 5). The channel "n" and overbank "n" values for the streams studied by detailed methods are shown in the following tabulation:

| Stream | Channel "n" | Overbank "n" |
|---|---|---|
| North Fork River | 0.023-0.095 | 0.035-0.085 |
| Stream A | 0.035-0.085 | 0.035-0.060 |
| Stream B | 0.030-0.080 | 0.040-0.050 |
| Stream C | 0.030-0.095 | 0.040-0.090 |
| Stream D | 0.035-0.085 | 0.040-0.070 |
| Little River | 0.020-0.090 | 0.035-0.100 |
| Stream E | 0.030-0.065 | 0.040-0.055 |

Water-surface elevations of floods of the selected recurrence intervals were computed using the U. S. Army Corps of Engineers (COE) HEC-2 step-backwater computer program (Reference 6). Flood profiles were drawn showing computed water-surface elevations for floods of the selected recurrence intervals.

Starting water-surface elevations for the North Fork River, the Little River, and Stream E were calculated by the slope/area method. Starting water-surface elevations for Streams A, B, C , and D were interpolated from the profiles of the North Fork River.

All elevations are referenced to the National Geodetic Vertical Datum of 1929 (NGVD). Elevation reference marks used in this study are shown on the maps.

The hydraulic analyses for this study were based on unobstructed flow. The flood elevations shown on the profiles are thus considered valid only if hydraulic structures remain unobstructed, operate properly, and do not fail.

## 4.C FLOOD PLAIN MANAGEMENT APPLICATIONS

The National Flood Insurance Program encourages State and local governments to adopt sound flood plain management programs. Therefore, each Flood Insurance Study produces maps designed to assist communities in developing flood plain management measures.



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## 4.1 Flood Boundaries

To provide a national standard without regional discrimination, the 1 percent annual chance (100-year) flood has been adopted by FEMA as the base flood for flood plain management purposes. The 0.2 percent annual chance (500-year) flood is employed to indicate additional areas of flood risk in the community. For each stream studied in detail, the 100- and 500-year flood plain boundaries have been delineated using the flood elevations determined at each cross section. Between cross sections, the boundaries were interpolated using topographic maps (Reference 7).

For the stream studied by approximate methods, the boundary of the 100-year flood was delineated using USGS flood-prone area maps. For Stream E, more accurate data obtained from field surveys were available at the most upstream area of approximate study.

The 100- and 500-year flood plain boundaries are shown on the Flood Boundary and Floodway Map (Exhibit 2). In cases where the 100- and 500-year flood plain boundaries are close together, only the 100-year flood plain boundary has been shown. Small areas within the flood plain boundaries may lie above the flood elevations but cannot be shown due to limitations of the map scale and/or lack of detailed topographic data.

## 4.2 Floodways

Encroachment on flood plains, such as structures and fill, reduces flood-carrying capacity, increases flood heights and velocities, and increases flood hazards in areas beyond the encroachment itself. One aspect of flood plain management involves balancing the economic gain from flood plain development against the resulting increase in flood hazard. For purposes of the National Flood Insurance Program, a floodway is used as a tool to assist local communities in this aspect of flood plain management. Under this concept, the area of the 100-year flood plain is divided into a floodway and a floodway fringe. The floodway is the channel of a stream, plus any adjacent flood plain areas, that must be kept free of encroachment so that the 100-year flood can be carried without substantial increases in flood heights. Minimum federal standards limit such increases to 1.0 foot, provided that hazardous velocities are not produced. The floodways in this study are presented to local agencies as minimum standards that can be adopted directly or that can be used as a basis for additional floodway studies.

The floodways presented in this study were computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations are tabulated at selected cross sections for each stream segment for which a floodway is computed (Table 2).

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| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FT.) | SECTION AREA (SQ. FT.) | MEAN VELOCITY (F.P.S.) | REGULATORY (NGVD) | WITHOUT FLOODWAY (NGVD) | WITH FLOODWAY (NGVD) | INCREASE (FEET) |
| North Fork River | | | | | | | | |
| A[2] | 10,000 | 358 | 1,996 | 3.8 | 1118.6 | 1118.6 | 1119.6 | 1.0 |
| B[2] | 11,180 | 329 | 1,524 | 4.7 | 1121.1 | 1121.1 | 1122.1 | 1.0 |
| C[2] | 12,420 | 407 | 1,748 | 4.1 | 1124.5 | 1124.5 | 1125.3 | 0.8 |
| D | 13,830 | 979 | 2,888 | 2.5 | 1127.3 | 1127.3 | 1128.1 | 0.8 |
| E | 14,760 | 342 | 1,729 | 4.1 | 1129.2 | 1129.2 | 1130.0 | 0.8 |
| F | 14,890 | 782 | 5,256 | 1.4 | 1134.2 | 1134.2 | 1134.2 | 0.0 |
| G | 15,490 | 810 | 1,237 | 5.8 | 1134.2 | 1134.2 | 1134.2 | 0.0 |
| H | 16,730 | 634 | 2,872 | 2.5 | 1135.7 | 1135.7 | 1136.6 | 0.9 |
| I | 16,846 | 581 | 2,797 | 2.5 | 1135.9 | 1135.9 | 1136.8 | 0.9 |
| J | 17,801 | 248 | 983 | 7.3 | 1137.5 | 1137.5 | 1138.2 | 0.7 |
| K | 19,021 | 536 | 1,793 | 3.5 | 1143.0 | 1143.0 | 1143.8 | 0.8 |
| L | 20,191 | 240 | 1,655 | 3.8 | 1144.8 | 1144.8 | 1145.7 | 0.9 |
| M | 20,696 | 172 | 1,109 | 4.5 | 1145.3 | 1145.3 | 1146.2 | 0.9 |
| N | 22,046 | 341 | 1,098 | 4.6 | 1148.5 | 1148.5 | 1149.3 | 0.8 |
| O | 22,966 | 363 | 854 | 6.0 | 1152.3 | 1152.3 | 1153.1 | 0.8 |
| P | 24,016 | 263 | 1,553 | 3.3 | 1156.2 | 1156.2 | 1157.0 | 0.8 |
| Q | 24,143 | 267 | 1,747 | 2.9 | 1157.4 | 1157.4 | 1158.2 | 0.8 |
| R | 25,298 | 223 | 1,364 | 3.7 | 1158.9 | 1158.9 | 1159.7 | 0.8 |
| S | 26,328 | 205 | 885 | 5.8 | 1160.9 | 1160.9 | 1161.7 | 0.8 |
| T | 27,603 | 72 | 477 | 7.2 | 1164.7 | 1164.7 | 1165.5 | 0.8 |
| U | 28,693 | 215 | 868 | 4.0 | 1169.1 | 1169.1 | 1170.0 | 0.9 |
| V | 28,999 | 284 | 1,393 | 2.5 | 1169.5 | 1169.5 | 1170.4 | 0.9 |

[1]Feet above mouth
[2]Outside corporate limits

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TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MOORE, OK
(CLEVELAND CO.)

FLOODWAY DATA

NORTH FORK RIVER

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FEET) | SECTION AREA (SQUARE FEET) | MEAN VELOCITY (FEET PER SECOND) | REGULATORY | WITHOUT FLOODWAY | WITH FLOODWAY | INCREASE |
| | | | | | (FEET NGVD) | | | |
| North Fork River (continued) | | | | | | | | |
| W | 30,144 | 70 | 316 | 10.9 | 1,171.5 | 1,171.5 | 1,171.6 | 0.1 |
| X | 31,084 | 164 | 808 | 4.3 | 1,177.8 | 1,177.8 | 1,178.8 | 1.0 |
| Y | 21,200 | 188 | 1,132 | 3.0 | 1,178.2 | 1,178.2 | 1,179.2 | 1.0 |
| Z | 31,585 | 231 | 1,067 | 3.2 | 1,178.7 | 1,178.7 | 1,179.7 | 1.0 |
| AA | 31,748 | 347 | 2,064 | 1.7 | 1,180.4 | 1,180.4 | 1,181.2 | 0.8 |
| AB | 32,893 | 66 | 356 | 8.1 | 1,180.8 | 1,180.8 | 1,181.5 | 0.7 |
| AC | 33,728 | 96 | 744 | 3.9 | 1,186.8 | 1,186.8 | 1,187.7 | 0.9 |
| AD | 33,914 | 395 | 2,301 | 1.2 | 1,187.3 | 1,187.3 | 1,188.2 | 0.9 |
| AE | 35,110 | 62 | 255 | 11.3 | 1,189.0 | 1,189.0 | 1,189.0 | 0.0 |
| AF | 36,220 | 62 | 262 | 11.0 | 1,195.5 | 1,195.5 | 1,195.5 | 0.0 |
| AG | 37,700 | 55 | 227 | 9.9 | 1,204.2 | 1,204.2 | 1,204.9 | 0.7 |
| AH | 39,790 | 32 | 166 | 13.0 | 1,217.6 | 1,217.6 | 1,218.3 | 0.7 |
| AI | 39,970 | 230 | 690 | 3.1 | 1,220.1 | 1,220.1 | 1,220.2 | 0.1 |
| AJ | 41,240 | 59 | 366 | 5.9 | 1,222.0 | 1,222.0 | 1,222.3 | 0.3 |
| AK | 41,897 | 34 | 169 | 12.8 | 1,224.4 | 1,224.4 | 1,224.5 | 0.1 |
| AL | 42,055 | 42 | 370 | 5.8 | 1,228.1 | 1,228.1 | 1,229.1 | 1.0 |
| AM | 43,285 | 58 | 218 | 9.9 | 1,230.6 | 1,230.6 | 1,230.6 | 0.0 |
| AN | 43,680 | 61 | 260 | 8.3 | 1,232.6 | 1,232.6 | 1,232.8 | 0.2 |
| AO | 44,863 | 55 | 171 | 7.3 | 1,240.7 | 1,240.7 | 1,240.7 | 0.0 |
| AP | 46,197 | 50 | 159 | 7.3 | 1,251.9 | 1,251.9 | 1,251.9 | 0.0 |

[1]Feet above mouth

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TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MOORE, OK

(CLEVELAND CO.)

FLOODWAY DATA



NORTH FORK RIVER

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FT.) | SECTION AREA (SQ. FT.) | MEAN VELOCITY (F.P.S.) | REGULATORY (NGVD) | WITHOUT FLOODWAY (NGVD) | WITH FLOODWAY (NGVD) | INCREASE (FEET) |
| Stream "A" | | | | | | | | |
| A[3] | 1,680 | 99 | 418 | 4.2 | 1121.1 | 1121.1 | 1122.1 | 1.0 |
| B | 3,310 | 160 | 372 | 4.7 | 1128.4 | 1128.4 | 1129.3 | 0.9 |
| C | 4,565 | 82 | 303 | 5.8 | 1135.8 | 1135.8 | 1136.5 | 0.7 |
| D | 5,655 | 43 | 246 | 6.3 | 1139.7 | 1139.7 | 1140.6 | 0.9 |
| E | 5,795 | 138 | 968 | 1.6 | 1143.7 | 1143.7 | 1144.5 | 0.8 |
| F | 6,265 | 170 | 812 | 1.9 | 1143.8 | 1143.8 | 1144.6 | 0.8 |
| G | 6,397 | 283 | 821 | 1.9 | 1143.9 | 1143.9 | 1144.7 | .8 |
| H | 6,717 | 155 | 470 | 3.3 | 1144.2 | 1144.2 | 1145.1 | 0.9 |
| Stream "B" | | | | | | | | |
| A | 200 | 108 | 618 | 2.7 | 1138.5 | 1137.5[2] | 1138.5 | 1.0 |
| B | 1,045 | 63 | 402 | 4.1 | 1143.1 | 1140.6[2] | 1140.8 | 0.2 |
| C | 1,955 | 117 | 497 | 3.3 | 1144.8 | 1143.0[2] | 1143.6 | 0.6 |
| D | 2,835 | 75 | 353 | 4.5 | 1148.5 | 1145.7[2] | 1146.7 | 1.0 |
| E | 4,090 | 116 | 336 | 4.7 | 1153.3 | 1153.3 | 1153.3 | 0.0 |
| F | 4,840 | 39 | 236 | 6.7 | 1156.8 | 1156.8 | 1157.3 | 0.5 |
| G | 4,992 | 107 | 623 | 2.6 | 1158.0 | 1158.0 | 1158.9 | 0.9 |
| H | 6,302 | 36 | 170 | 8.6 | 1160.6 | 1160.6 | 1160.9 | 0.3 |
| Stream "C" | | | | | | | | |
| A | 170 | 83 | 610 | 4.6 | 1164.0 | 1164.0 | 1165.0 | 1.0 |
| B | 1,585 | 85 | 556 | 5.1 | 1167.0 | 1167.0 | 1168.0 | 1.0 |

[1]Feet above mouth
[2]Elevations computed without considering backwater effects.
[3]Outside corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MOORE, OK

(CLEVELAND CO.)

FLOODWAY DATA

STREAM "A"- STREAM "B"- STREAM "C"



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| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FT.) | SECTION AREA (SQ. FT.) | MEAN VELOCITY (F.P.S.) | REGULATORY (NGVD) | WITHOUT FLOODWAY (NGVD) | WITH FLOODWAY (NGVD) | INCREASE (FEET) |
| Stream "C"(cont.) | | | | | | | | |
| C | 2,975 | 64 | 297 | 9.5 | 1174.0 | 1174.0 | 1174.0 | 0.0 |
| D | 4,240 | 72 | 538 | 4.5 | 1179.8 | 1179.8 | 1180.5 | 0.7 |
| E | 4,386 | 93 | 609 | 4.0 | 1180.3 | 1180.3 | 1181.0 | 0.7 |
| F | 5,681 | 86 | 465 | 5.2 | 1183.7 | 1183.7 | 1184.6 | 0.9 |
| G | 7,181 | 142 | 756 | 3.0 | 1189.3 | 1189.3 | 1189.8 | 0.5 |
| H | 8,336 | 72 | 311 | 7.4 | 1194.9 | 1194.9 | 1195.1 | 0.2 |
| I | 9,576 | 85 | 479 | 4.4 | 1202.6 | 1202.6 | 1203.5 | 0.9 |
| J | 10,806 | 91 | 436 | 4.9 | 1209.3 | 1209.3 | 1209.8 | 0.5 |
| K[3] | 10,950 | 84 | 528 | 4.0 | 1210.6 | 1210.6 | 1211.3 | 0.7 |
| L[4] | 12,360 | 60 | 325 | 5.5 | 1216.5 | 1216.5 | 1217.4 | 0.9 |
| M[3] | 13,860 | 53 | 400 | 4.4 | 1224.0 | 1224.0 | 1224.7 | 0.7 |
| N | 14,880 | 85 | 325 | 5.5 | 1228.5 | 1228.5 | 1229.5 | 1.0 |
| Stream "D" | | | | | | | | |
| A | 70 | 68 | 420 | 5.7 | 1145.3 | 1139.6[2] | 1140.6 | 1.0 |
| B | 895 | 61 | 334 | 7.2 | 1145.5 | 1145.2[2] | 1146.2 | 1.0 |
| C | 2,290 | 75 | 503 | 4.7 | 1152.7 | 1152.7 | 1153.5 | 0.8 |
| D | 3,585 | 76 | 434 | 5.4 | 1157.1 | 1157.1 | 1158.1 | 1.0 |
| E | 3,715 | 93 | 550 | 4.3 | 1158.3 | 1158.3 | 1159.0 | 0.7 |
| F | 5,365 | 130 | 496 | 4.5 | 1162.5 | 1162.5 | 1163.5 | 1.0 |
| G | 6,760 | 89 | 456 | 4.2 | 1168.8 | 1168.8 | 1169.6 | 0.8 |
| H | 6,896 | 160 | 454 | 4.2 | 1170.0 | 1170.0 | 1170.8 | 0.8 |

[1]Feet above mouth
[2]Elevations computed without considering backwater effects
[3]Outside corporate limits.
[4]Floodway extends beyond corporate limits.

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MOORE, OK
(CLEVELAND CO.)

FLOODWAY DATA



STREAM "C" - STREAM "D"

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| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FT.) | SECTION AREA (SQ. FT.) | MEAN VELOCITY (F.P.S.) | REGULATORY (NGVD) | WITHOUT FLOODWAY (NGVD) | WITH FLOODWAY (NGVD) | INCREASE (FEET) |
| Stream "D" (cont.) | | | | | | | | |
| I | 8,191 | 56 | 340 | 5.1 | 1174.6 | 1174.6 | 1175.5 | 0.9 |
| J | 9,931 | 70 | 334 | 5.2 | 1182.0 | 1182.0 | 1182.9 | 0.9 |
| K | 11,151 | 94 | 286 | 5.4 | 1189.3 | 1189.3 | 1190.1 | 0.8 |
| L | 11,941 | 143 | 317 | 4.9 | 1194.5 | 1194.5 | 1195.3 | 0.8 |
| Little River | | | | | | | | |
| A | 0 | 170 | 2,295 | 2.3 | 1158.2 | 1158.2 | 1159.2 | 1.0 |
| B | 720 | 95 | 610 | 6.2 | 1161.7 | 1161.7 | 1162.7 | 1.0 |
| C | 1,420 | 155 | 878 | 4.3 | 1165.7 | 1165.7 | 1166.7 | 1.0 |
| D* | 2,730 | 275 | 1,079 | 3.5 | 1169.7 | 1169.7 | 1170.6 | 0.9 |
| E* | 3,465 | 111[2] | 477 | 7.9 | 1172.2 | 1172.2 | 1172.8 | 0.6 |
| F | 4,440 | 461[2] | 1,530 | 2.5 | 1175.4 | 1175.4 | 1176.3 | 0.9 |
| G | 4,592 | 474 | 1,978 | 1.9 | 1176.8 | 1176.8 | 1177.7 | 0.9 |
| H | 5,812 | 308 | 1,269 | 2.9 | 1177.8 | 1177.8 | 1178.7 | 0.9 |
| I | 6,642 | 731 | 1,646 | 2.2 | 1179.0 | 1179.0 | 1179.8 | 0.8 |
| J | 7,051 | 101 | 482 | 7.6 | 1181.7 | 1181.7 | 1181.7 | 0.0 |
| K | 8,351 | 150 | 991 | 3.7 | 1185.1 | 1185.1 | 1186.0 | 0.9 |
| L | 9,741 | 224 | 956 | 3.8 | 1187.6 | 1187.6 | 1188.4 | 0.8 |
| M | 11,166 | 400 | 1,098 | 3.3 | 1190.5 | 1190.5 | 1191.3 | 0.8 |
| N | 11,876 | 135 | 718 | 4.3 | 1192.0 | 1192.0 | 1192.8 | 0.8 |
| O | 12,016 | 196 | 828 | 3.7 | 1193.2 | 1193.2 | 1194.0 | 0.8 |
| P | 12,166 | 60 | 324 | 9.4 | 1193.2 | 1193.2 | 1193.8 | 0.6 |

*Outside corporate limits
[1]Feet above mouth for Stream "D"; feet above southern corporate limits for Little River
[2]Floodway extends outside corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MOORE, OK
(CLEVELAND CO.)

FLOODWAY DATA

STREAM "D"-LITTLE RIVER



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| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FT.) | SECTION AREA (SQ. FT.) | MEAN VELOCITY (F.P.S.) | REGULATORY (NGVD) | WITHOUT FLOODWAY (NGVD) | WITH FLOODWAY (NGVD) | INCREASE (FEET) |
| Little River (continued) | | | | | | | | |
| Q | 12,366 | 200 | 735 | 4.2 | 1195.1 | 1195.1 | 1196.0 | 0.9 |
| R | 13,546 | 82 | 437 | 7.0 | 1198.4 | 1198.4 | 1199.0 | 0.6 |
| S | 13,688 | 82 | 462 | 6.6 | 1199.4 | 1199.4 | 1199.8 | 0.4 |
| T | 14,963 | 62 | 533 | 5.6 | 1203.3 | 1203.3 | 1203.8 | 0.5 |
| U | 16,388 | 55 | 456 | 6.6 | 1207.1 | 1207.1 | 1207.9 | 0.8 |
| V | 17,398 | 56 | 357 | 8.3 | 1212.5 | 1212.5 | 1212.7 | 0.2 |
| W | 18,228 | 85 | 596 | 5.0 | 1215.5 | 1215.5 | 1216.0 | 0.5 |
| X | 18,396 | 59 | 398 | 7.5 | 1216.6 | 1216.6 | 1216.8 | 0.2 |
| Y | 19,386 | 108 | 484 | 6.1 | 1219.4 | 1219.4 | 1220.0 | 0.6 |
| Z | 19,522 | 208 | 827 | 3.6 | 1220.2 | 1220.2 | 1221.1 | 0.9 |
| AA | 20,142 | 48 | 441 | 6.7 | 1221.7 | 1221.7 | 1222.6 | 0.9 |
| AB | 21,622 | 197 | 387 | 5.6 | 1228.7 | 1228.7 | 1229.4 | 0.7 |
| AC | 21,844 | 82 | 603 | 3.4 | 1231.2 | 1231.2 | 1231.7 | 0.5 |
| AD | 22,377 | 81 | 534 | 3.8 | 1233.6 | 1233.6 | 1234.1 | 0.5 |
| AE | 24,327 | 42 | 160 | 11.2 | 1238.6 | 1238.6 | 1238.6 | 0.0 |
| AF | 24,483 | 223 | 978 | 1.8 | 1244.9 | 1244.9 | 1245.4 | 0.5 |
| AG | 24,743 | 172 | 788 | 2.1 | 1245.1 | 1245.1 | 1245.6 | 0.5 |
| AH | 24,893 | 235 | 1,116 | 1.5 | 1245.2 | 1245.2 | 1245.6 | 0.4 |
| AI | 25,623 | 45 | 213 | 7.9 | 1245.2 | 1245.2 | 1246.9 | 0.7 |

[1]Feet above southern corporate limits

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MOORE, OK

(CLEVELAND CO.)

FLOODWAY DATA

34

LITTLE RIVER

| FLOODING SOURCE | | FLOODWAY | | | BASE FLOOD WATER SURFACE ELEVATION | | | |
|---|---|---|---|---|---|---|---|---|
| CROSS SECTION | DISTANCE[1] | WIDTH (FT.) | SECTION AREA (SQ. FT.) | MEAN VELOCITY (F.P.S.) | REGULATORY (NGVD) | WITHOUT FLOODWAY (NGVD) | WITH FLOODWAY (NGVD) | INCREASE (FEET) |
| Stream "E" | | | | | | | | |
| A | 9,300 | 241 | 908 | 2.7 | 1174.6 | 1174.6 | 1175.6 | 1.0 |
| B | 10,500 | 374 | 1,059 | 2.0 | 1177.5 | 1177.5 | 1178.4 | 0.9 |
| C | 10,624 | 506 | 1,612 | 1.3 | 1178.3 | 1178.3 | 1179.3 | 1.0 |
| D | 11,674 | 108 | 321 | 6.4 | 1179.1 | 1179.1 | 1179.7 | 0.6 |
| E | 12,524 | 175 | 444 | 4.2 | 1183.9 | 1183.9 | 1184.8 | 0.9 |
| F | 13,534 | 202 | 555 | 2.9 | 1186.8 | 1186.8 | 1187.7 | 0.9 |
| G | 14,584 | 72 | 216 | 7.4 | 1190.6 | 1190.6 | 1191.1 | 0.5 |

[1]Feet above mouth

TABLE 2

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MOORE, OK

(CLEVELAND CO.)

FLOODWAY DATA

STREAM "E"

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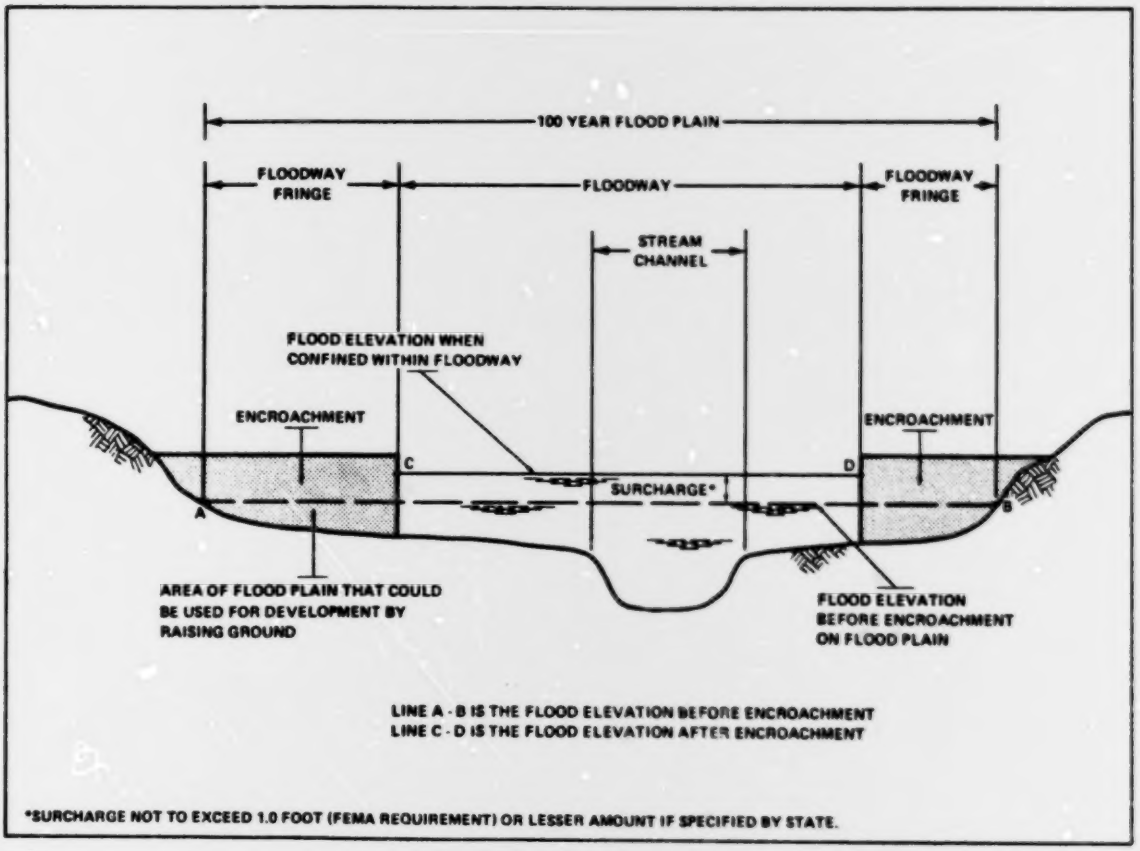
As shown on the Flood Boundary and Floodway Map (Exhibit 2), the floodway boundaries were computed at cross sections. Between cross sections, the boundaries were interpolated. In cases where the floodway and 100-year flood plain boundaries are either close together or collinear, only the floodway boundary has been shown.

The area between the floodway and 100-year flood plain boundaries is termed the floodway fringe. The floodway fringe encompasses the portion of the flood plain that could be completely obstructed without increasing the water-surface elevation of the 100-year flood by more than 1.0 foot at any point. Typical relationships between the floodway and the floodway fringe and their significance to flood plain developments are shown in Figure 11.


100 YEAR FLOOD PLAIN
FLOODWAY FRINGE
FLOODWAY
FLOODWAY FRINGE
STREAM CHANNEL
FLOOD ELEVATION WHEN CONFINED WITHIN FLOODWAY
ENCROACHMENT
ENCROACHMENT
C
D
SURCHARGE*
A
B
AREA OF FLOOD PLAIN THAT COULD BE USED FOR DEVELOPMENT BY RAISING GROUND
FLOOD ELEVATION BEFORE ENCROACHMENT ON FLOOD PLAIN
LINE A - B IS THE FLOOD ELEVATION BEFORE ENCROACHMENT
LINE C - D IS THE FLOOD ELEVATION AFTER ENCROACHMENT
*SURCHARGE NOT TO EXCEED 1.0 FOOT (FEMA REQUIREMENT) OR LESSER AMOUNT IF SPECIFIED BY STATE.

FLOODWAY SCHEMATIC

Figure 11

Near the mouths of streams studied in detail, floodway computations are made without regard to flood elevations on the receiving water body. Therefore, "Without Floodway" elevations presented in Table 3 for certain downstream cross sections of Stream B and Stream D are lower than the regulatory flood elevations in that area, which must take into account the 100-year flooding due to backwater from other sources.



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## 5.0 INSURANCE APPLICATION

To establish actuarial insurance rates, data from the engineering study must be transformed into flood insurance criteria. This process includes the determination of reaches, Flood Hazard Factors, and flood insurance zone designations for each flooding source studied in detail in the City of Moore.

### 5.1 Reach Determinations

Reaches are defined as sections of flood plain that have relatively the same flood hazard, based on the average weighted difference in water-surface elevations between the 10- and 100-year floods. This difference may not have a variation greater than that indicated in the following tabulation for more than 20 percent of the reach:

| Average Difference Between 10- and 100-Year Floods | Variation |
|---|---|
| Less than 2 feet | 0.5 foot |
| 2 to 7 feet | 1.0 foot |
| 7.1 to 12 feet | 2.0 feet |
| More than 12 feet | 3.0 feet |

The locations of the reaches determined for the flooding sources of the City of Moore are shown on the Flood Profiles (Exhibit 1) and summarized in Table 3.

### 5.2 Flood Hazard Factors

The Flood Hazard Factor (FHF) is used to establish relationships between depth and frequency of flooding in any reach. This relationship is then used with depth-damage relationships for various classes of structures to establish actuarial insurance rate tables.

The FHF for a reach is the average weighted difference between the 10- and 100-year flood water-surface elevations rounded to the nearest one-half foot, multiplied by 10, and shown as a three-digit code. For example, if the difference between water-surface elevations of the 10- and 100-year floods is 0.7 foot, the FHF is 005; if the difference is 1.4 feet, the FHF is 015; if the difference is 5.0 feet, the FHF is 050. When the difference between the 10- and 100-year flood water-surface elevations is greater than 10.0 feet, it is rounded to the nearest whole foot.

### 5.3 Flood Insurance Zones

Flood insurance zones and zone numbers are assigned based on the type of flood hazard and the FHF, respectively. A unique zone number is



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| FLOODING SOURCE | PANEL[1] | ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND | | | FHF | ZONE | BASE FLOOD ELEVATION[3] (NGVD) |
|---|---|---|---|---|---|---|---|
| | | 10% (10 YR.) | 2% (50 YR.) | 0.2% (500 YR.) | | | |
| North Fork River | | | | | | | |
| Reach 1 | 0004 | -1.33 | -0.42 | 0.84 | 015 | A3 | Varies |
| Reach 2 | 0004 | -2.00 | -0.46 | 0.90 | 020 | A4 | Varies |
| Reach 3 | 0004,0002 | -1.42 | -0.46 | 1.36 | 015 | A3 | Varies |
| Reach 4 | 0001,0002 | -2.01 | -0.56 | 1.02 | 020 | A4 | Varies |
| Reach 5 | 0001 | -1.53 | -0.48 | 0.72 | 015 | A3 | Varies |
| Reach 6 | 0001 0004 | -2.08 | -0.34 | 0.81 | 020 | A4 | Varies |
| Stream "A" | | | | | | | |
| Reach 1 | 0004 | -0.94 | -0.27 | 0.50 | 010 | A2 | Varies |
| Stream "B" | | | | | | | |
| Reach 1 | 0004 | -1.72 | -0.52 | 0.71 | 015 | A3 | Varies |
| Stream "C" | | | | | | | |
| Reach 1 | 0002,0004 | -1.72 | -0.50 | 0.96 | 015 | A3 | Varies |

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT – SEE MAP

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

# CITY OF MOORE, OK

(CLEVELAND CO.)

## FLOOD INSURANCE ZONE DATA

## NORTH FORK RIVER · STREAM "A" · STREAM "B" · STREAM "C"

| FLOODING SOURCE | PANEL[1] | ELEVATION DIFFERENCE[2] BETWEEN 1.0% (100-YEAR) FLOOD AND | | | FHF | ZONE | BASE FLOOD ELEVATION[3] (NGVD) |
|---|---|---|---|---|---|---|---|
| | | 10% (10 YR.) | 2% (50 YR.) | 0.2% (500 YR.) | | | |
| Stream "D" Reach 1 | 0003,0004 | -1.22 | -0.32 | 0.55 | 010 | A2 | Varies |
| Little River | | | | | | | |
| Reach 1 | 0003 | -1.24 | -0.37 | 0.84 | 010 | A2 | Varies |
| Reach 2 | 0001,0003 | -2.15 | -0.58 | 1.07 | 020 | A4 | Varies |
| Stream "E" Entire stream as 1 Reach | 0003 | -0.69 | -0.21 | 0.46 | 005 | A1 | Varies |

[1]FLOOD INSURANCE RATE MAP PANEL
[2]WEIGHTED AVERAGE
[3]ROUNDED TO NEAREST FOOT – SEE MAP

TABLE 3

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MOORE, OK

(CLEVELAND CO.)

FLOOD INSURANCE ZONE DATA

STREAM "D" - LITTLE RIVER - STREAM "E"



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associated with each possible FHF, and varies from 1 for a FHF of 005 to a maximum of 30 for a FHF of 200 or greater.

| | |
|---|---|
| Zone A: | Special Flood Hazard Areas inundated by the 100-year flood, determined by approximate methods; no base flood elevations shown or FHFs determined. |
| Zones A1, A2, A3, and A4: | Special Flood Hazard Areas inundated by the 100-year flood; with base flood elevations shown, and zones subdivided according to FHFs. |
| Zone B: | Areas between the Special Flood Hazard Areas and the limits of the 500-year flood; areas that are protected from the 100- or 500-year floods by dike, levee, or other water control structure; areas subject to certain types of 100-year shallow flooding where depths are less than 1.0 foot; and areas subject to 100-year flooding from sources with drainage areas less than 1 square mile. Zone B is not subdivided. |
| Zone C: | Areas of minimal flooding; not subdivided. |

Flood elevation differences, FHFs, flood insurance zones, and base flood elevations for the flooding sources studied in detail in the community are shown in Table 3.

### 5.4 Flood Insurance Rate Map Description

The Flood Insurance Rate Map for the City of Moore is, for insurance purposes, the principal result of the Flood Insurance Study. This map contains the official delineation of flood insurance zones and base flood elevations. Base flood elevation lines show the locations of the expected whole-foot water-surface elevation of the base (100-year) flood. The base flood elevations and zone numbers are used by insurance agents, in conjunction with structure elevations and characteristics, to assign actuarial insurance rates to structures and contents insured under the National Flood Insurance Program.

## 6.0 OTHER STUDIES

The Flood Insurance Studies for the Cities of Oklahoma City and Norman are currently being revised (References 8 and 9). The results of those studies will be in exact agreement with the results of this study.



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## 7.0 LOCATION OF DATA

Information concerning the pertinent data used in preparation of this study can be obtained by contacting the Natural and Technological Hazards Division, Federal Emergency Management Agency, Regional Director, Region VI, Federal Center, Denton, Texas 76201.

## 8.0 BIBLIOGRAPHY AND REFERENCES


1. The Norman Transcript, Norman, Oklahoma, September 22, 1970.

2. The Moore Monitor, Moore, Oklahoma, September 24, 1970.

3. U. S. Department of the Interior, Geological Survey, Water Resources Investigation 77-54, Techniques for Estimating Flood Discharges for Oklahoma Streams.

4. Ven Te Chow, Open-Channel Hydraulics, New York, McGraw-Hill, 1959.

5. U. S. Department of Commerce, Bureau of Public Roads, Hydraulic Design Series No. 4, Design of Roadside Drainage Channels, Washington, D. C., 1965.

6. U. S. Army Corps of Engineers, Hydrologic Engineering Center, HEC-2 Water Surface Profiles, Generalized Computer Program, Davis, California, October 1973.

7. U. S. Department of the Interior, Geological Survey, 7.5-Minute Series Topographic Maps, Scale 1:24,000, Contour Interval 10 Feet: Moore, Oklahoma, 1956, Photorevised 1969 and 1975; Oklahoma City, Oklahoma, 1956, Photorevised 1969.

8. Federal Emergency Management Agency, Flood Insurance Study, City of Oklahoma City, Oklahoma County, Oklahoma, Washington, D. C., May 3, 1982.

9. Federal Emergency Management Agency, Federal Insurance Administration, Flood Insurance Study, City of Norman, Cleveland County, Oklahoma, Washington, D. C., May 1, 1979.

U. S. Department of Agriculture, Soil Conservation Service, Soil Survey, Cleveland County, Oklahoma, Washington, D. C., October 1954.




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TEXT REVISIONS
CITY OF MOORE, OKLAHOMA

## 9.0 REVISION DESCRIPTION

### 9.1 Purpose

The purpose of this revision is to incorporate new and/or revised data into the currently effective Flood Insurance Study for the City of Moore, Cleveland County, Oklahoma. This Revision Description is intended to provide updated information which aids in the administration of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973.

### 9.2 Acknowledgments

The hydrologic and hydraulic data for this Revision Description were performed by Poe & Associates of Oklahoma City, Inc. The Federal Emergency Management Agency (FEMA) reviewed and accepted the data for purposes of this revision.

### 9.3 Scope

This revision incorporated changes to the North Fork River upstream of NE 18th Street (extended) and continued approximately 1,500 feet beyond the previous limit of detailed study. This revision was done due to the channelization done as a result of construction of the East Hills Addition, Sections V and VI. The limit of detailed study for the North Fork River is now located approximately 500 feet above NE 23rd Street.

### 9.4 Hydrologic and Hydraulic Analyses

The hydraulic analysis for the North Fork River was revised to include the channelization and the addition of two new bridges on the stream. The analysis was also done to include the addition of detailed study upstream. Flood Profile (Exhibit 1) Panel 03 was revised to exhibit these changes. Table 1, "Summary of Discharges", is a summary of the drainage area-peak discharge relationships for the streams studied by detailed methods. An addendum for the summary of the drainage area-peak discharge relationships for the additional detailed study for the North Fork River is shown in the following tabulation.



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## SUMMARY OF DISCHARGES ADDENDUM

| FLOODING SOURCE AND LOCATION | DRAINAGE AREA (sq. miles) | PEAK DISCHARGES (cfs) 10-YEAR | 50-YEAR | 100-YEAR | 500-YEAR |
|---|---|---|---|---|---|
| NORTH FORK RIVER | | | | | |
| At East Hill Drive | 1.14 | 816 | 1,354 | 1,629 | 2,308 |
| Downstream of NE 22nd Street | 1.08 | 631 | 1,045 | 1,254 | 1,770 |

### 9.5 Floodways

Floodway computations for the North Fork River were revised as a result of a channelization and the extension of the limit of detailed study. The floodway was computed on the basis of equal conveyance reduction from each side of the flood plain. The results of these computations were tabulated at selected cross sections for each stream segment for which a floodway was revised and are included in Table 2, "Floodway Data."



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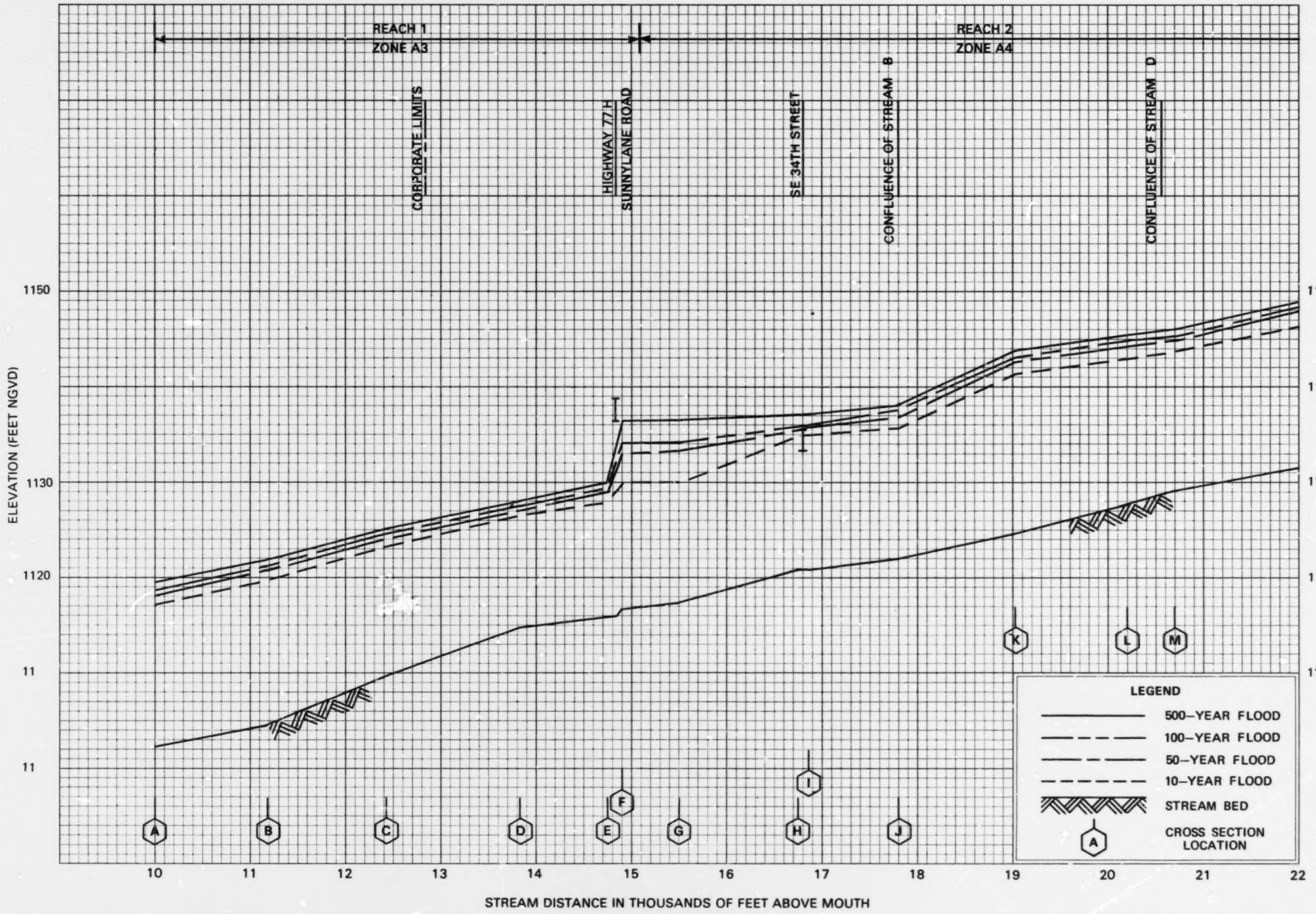


FLOOD PROFILES

NORTH FORK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MOORE, OK
(CLEVELAND CO.)

01P

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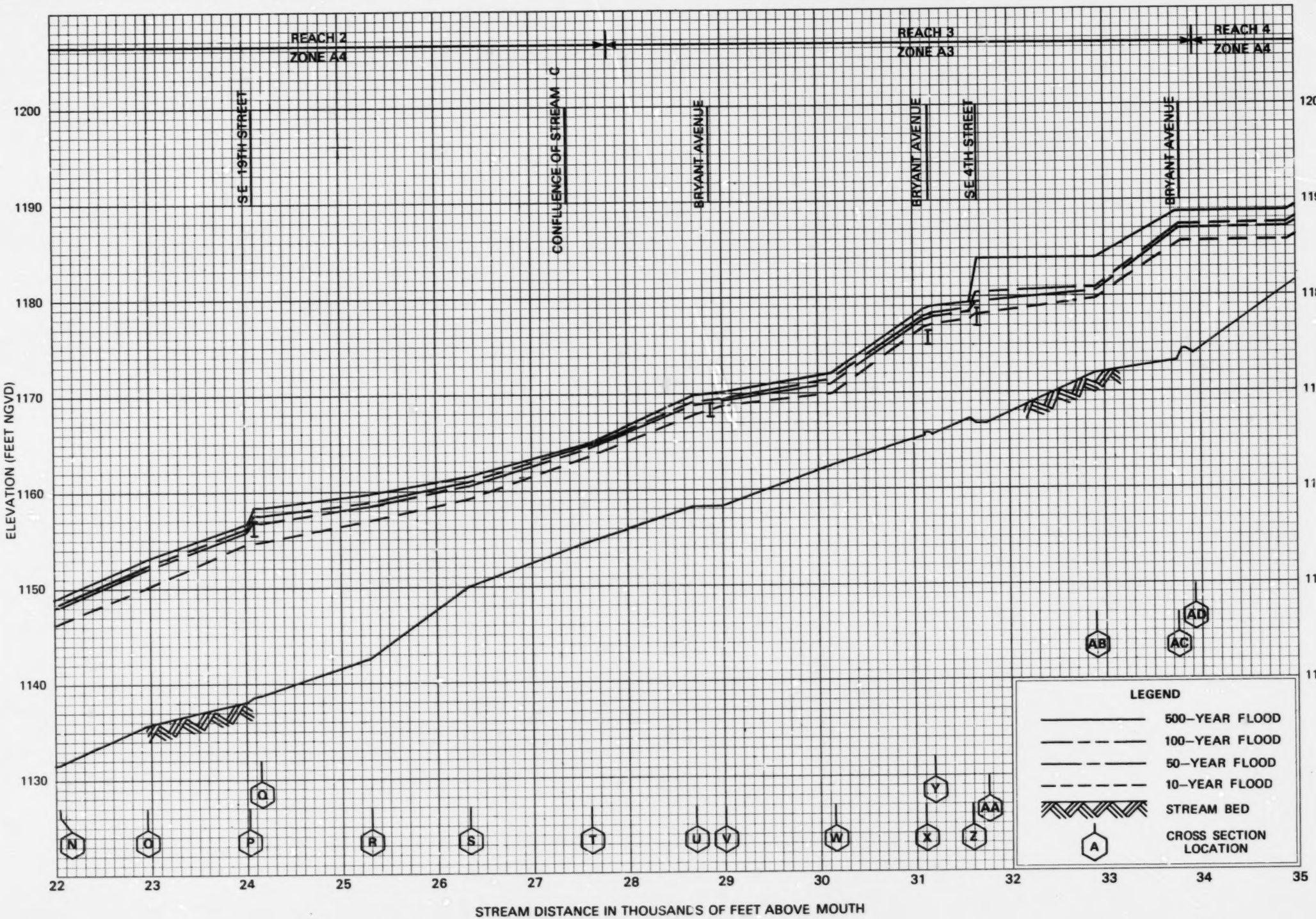


FLOOD PROFILES

NORTH FORK RIVER

FEDERAL EMERGENCY MANAGEMENT AGENCY

CITY OF MOORE, OK
(CLEVELAND CO.)

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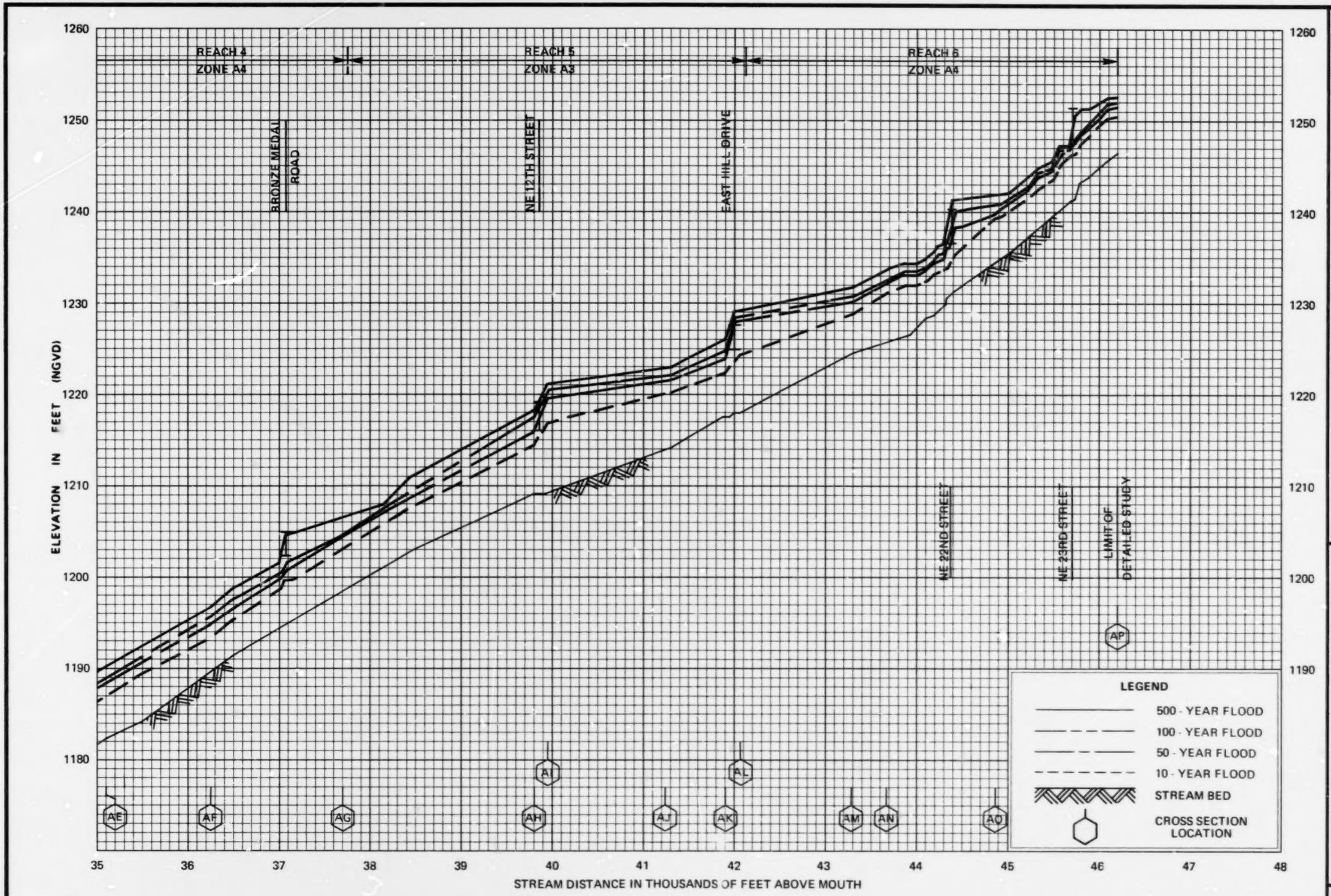


FLOOD PROFILES

NORTH FORK RIVER

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CITY OF MOORE, OK
(CLEVELAND CO.)

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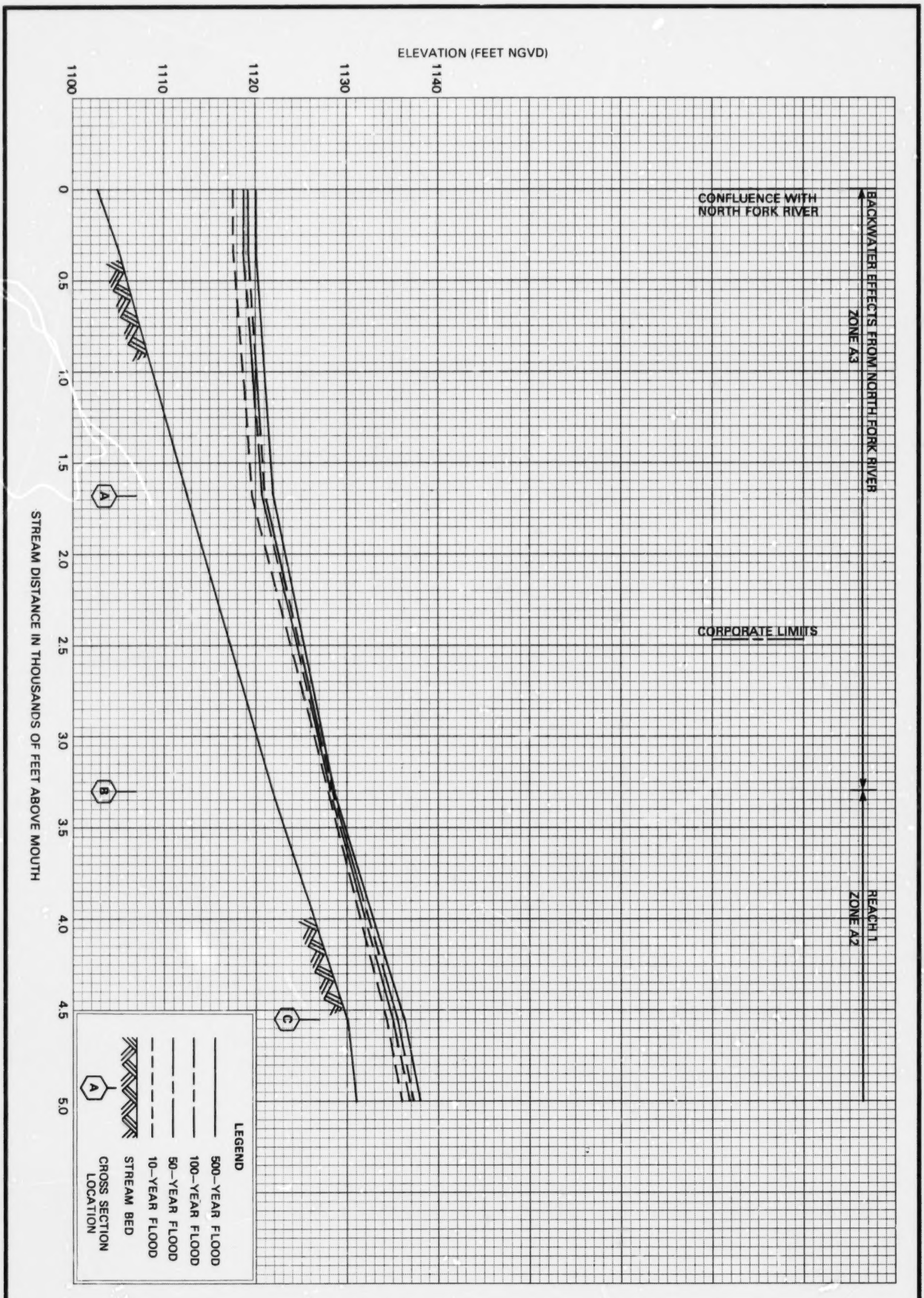


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04P

FLOOD PROFILES

STREAM A

37

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FLOOD PROFILES

STREAM A

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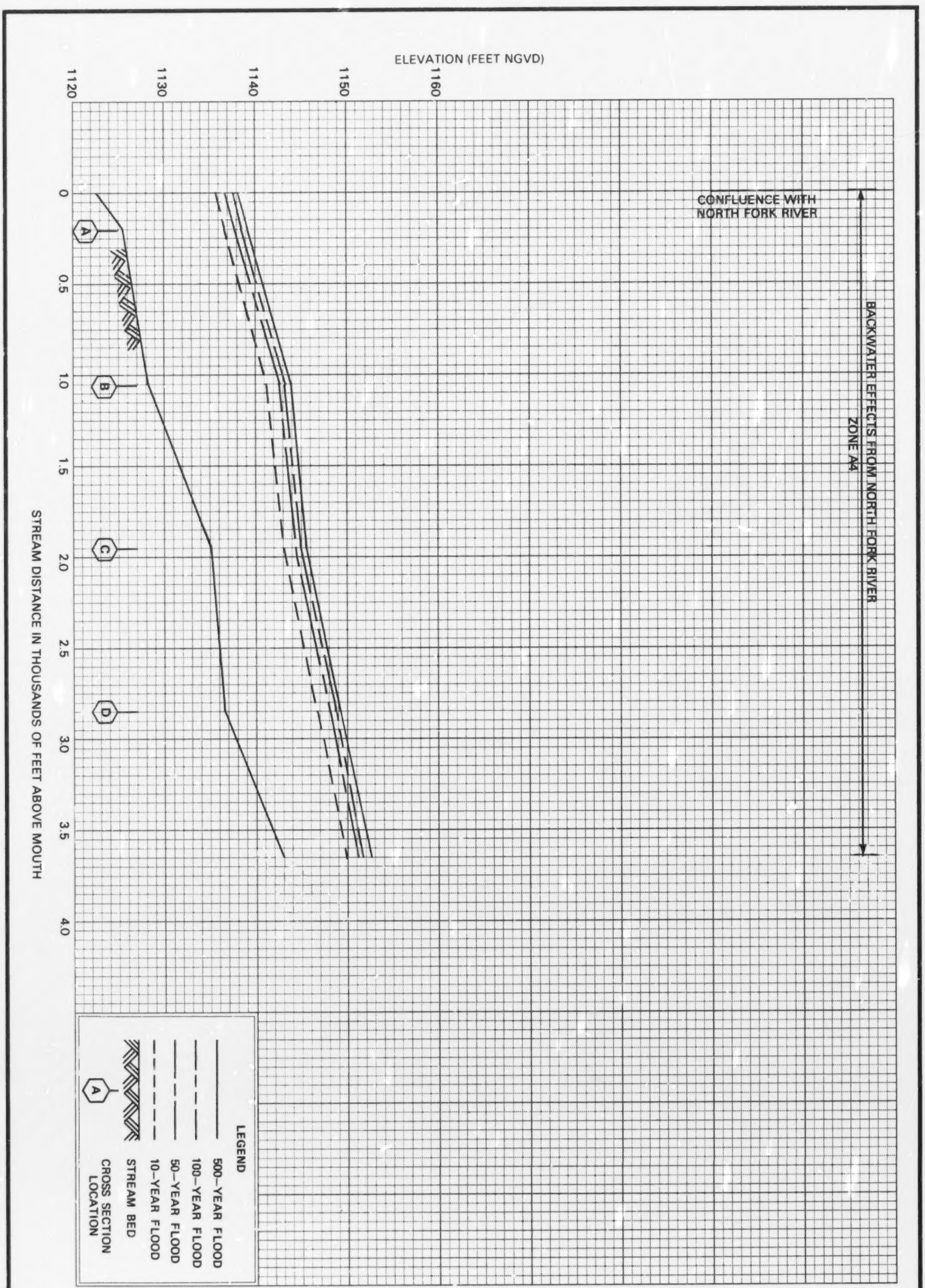


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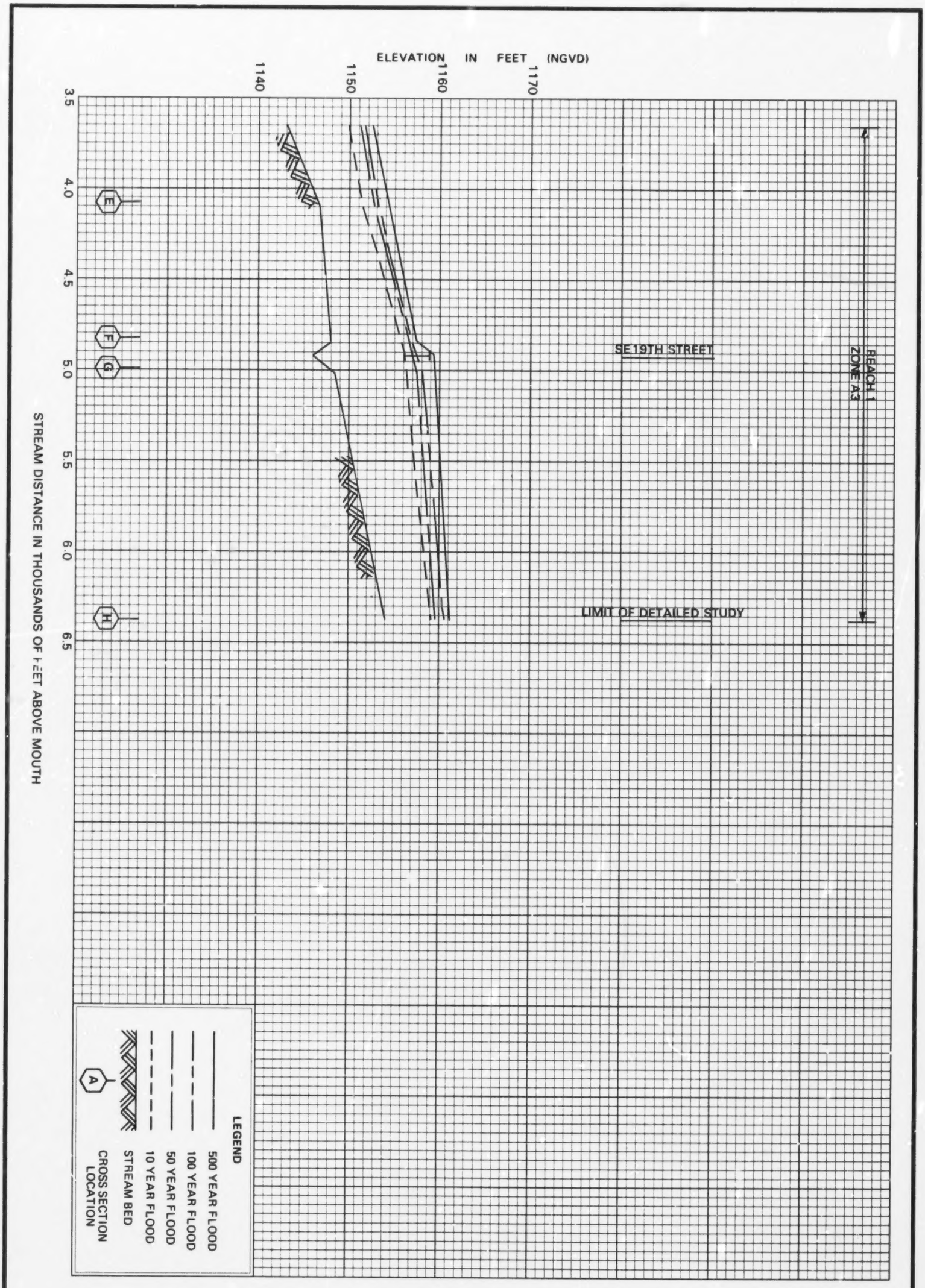


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**CITY OF MOORE, OK**
(CLEVELAND CO.)

**FLOOD PROFILES**

**STREAM B**

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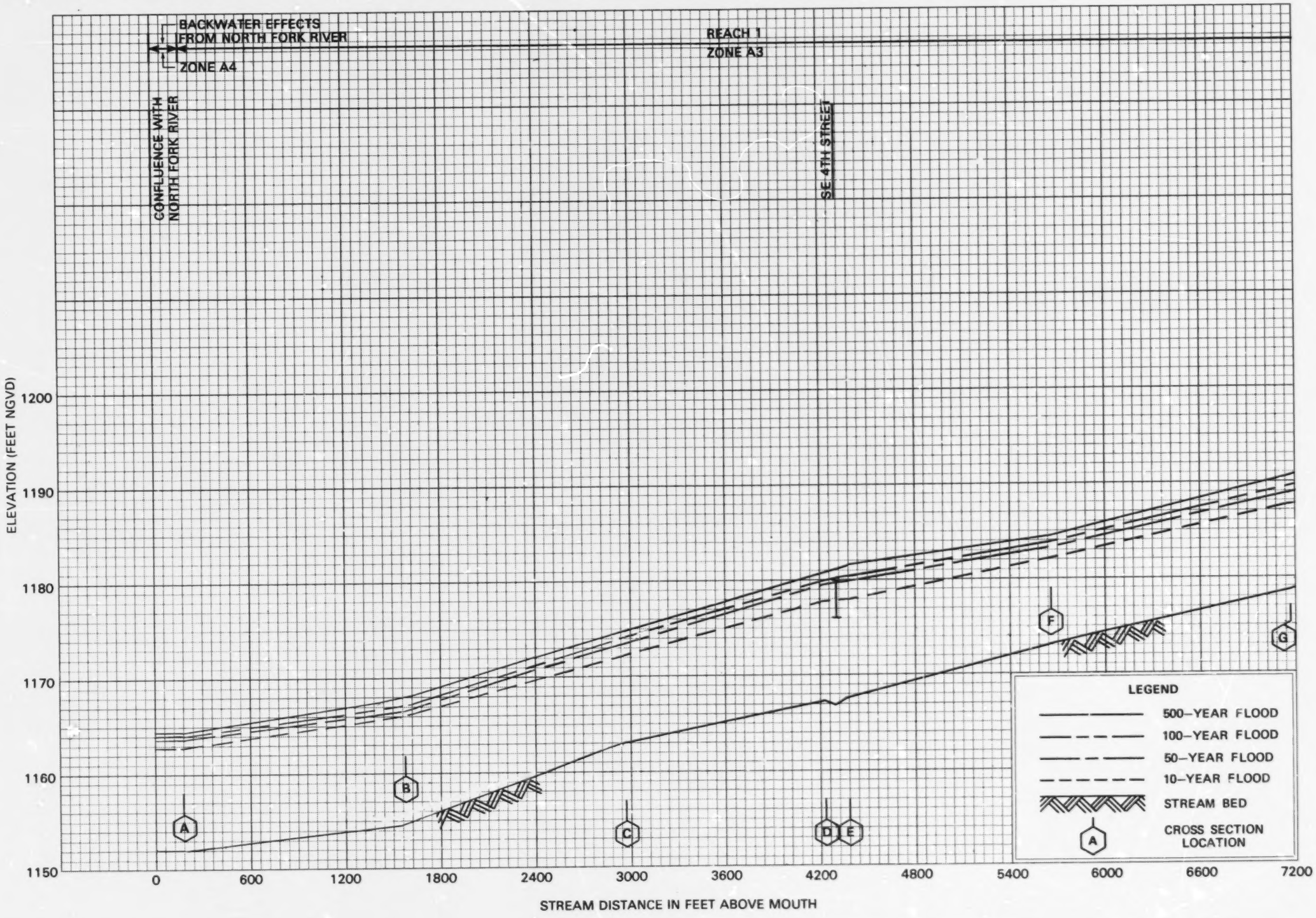


FLOOD PROFILES

STREAM C

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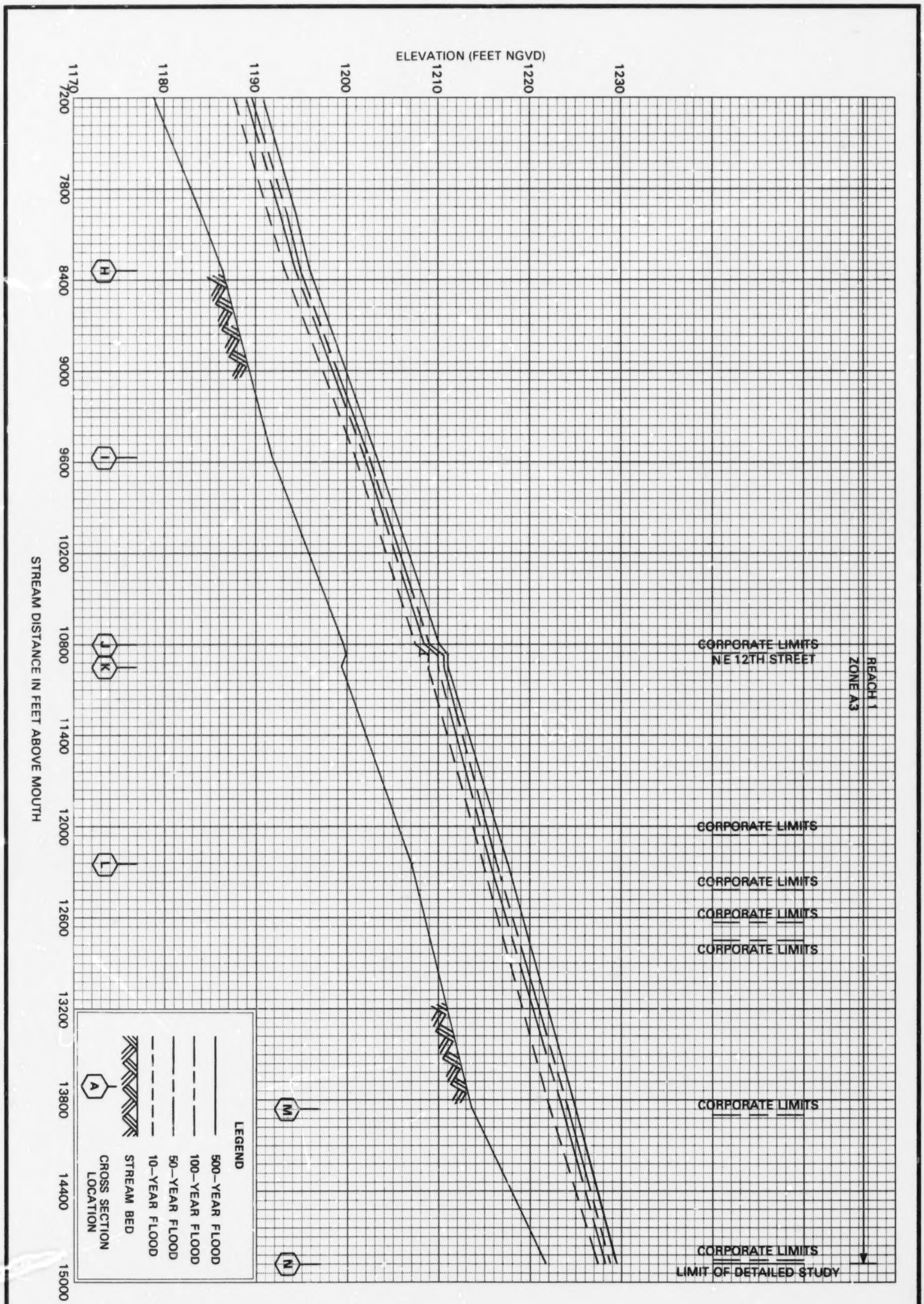


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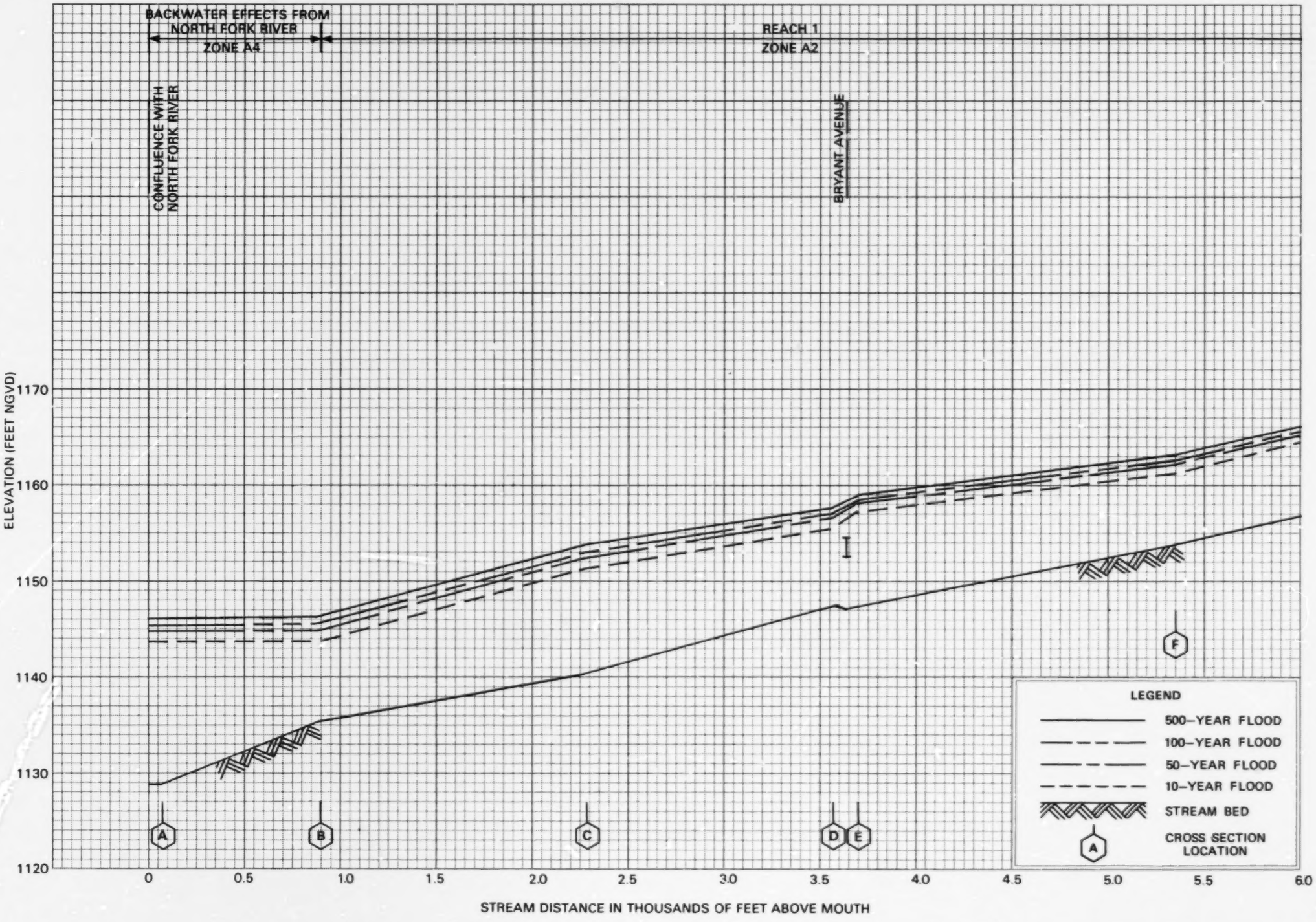


FLOOD PROFILES

STREAM D

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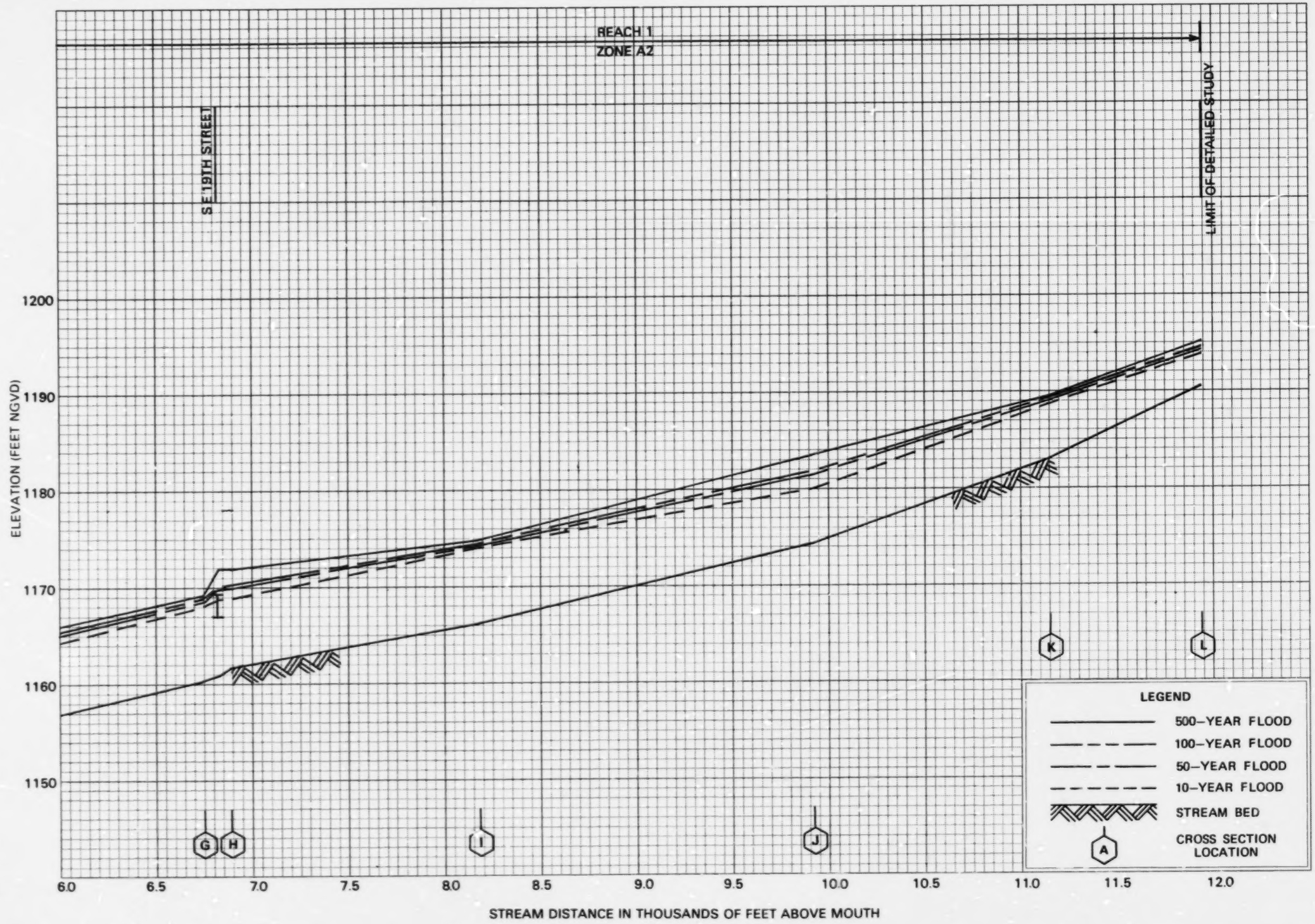


FLOOD PROFILES

STREAM D

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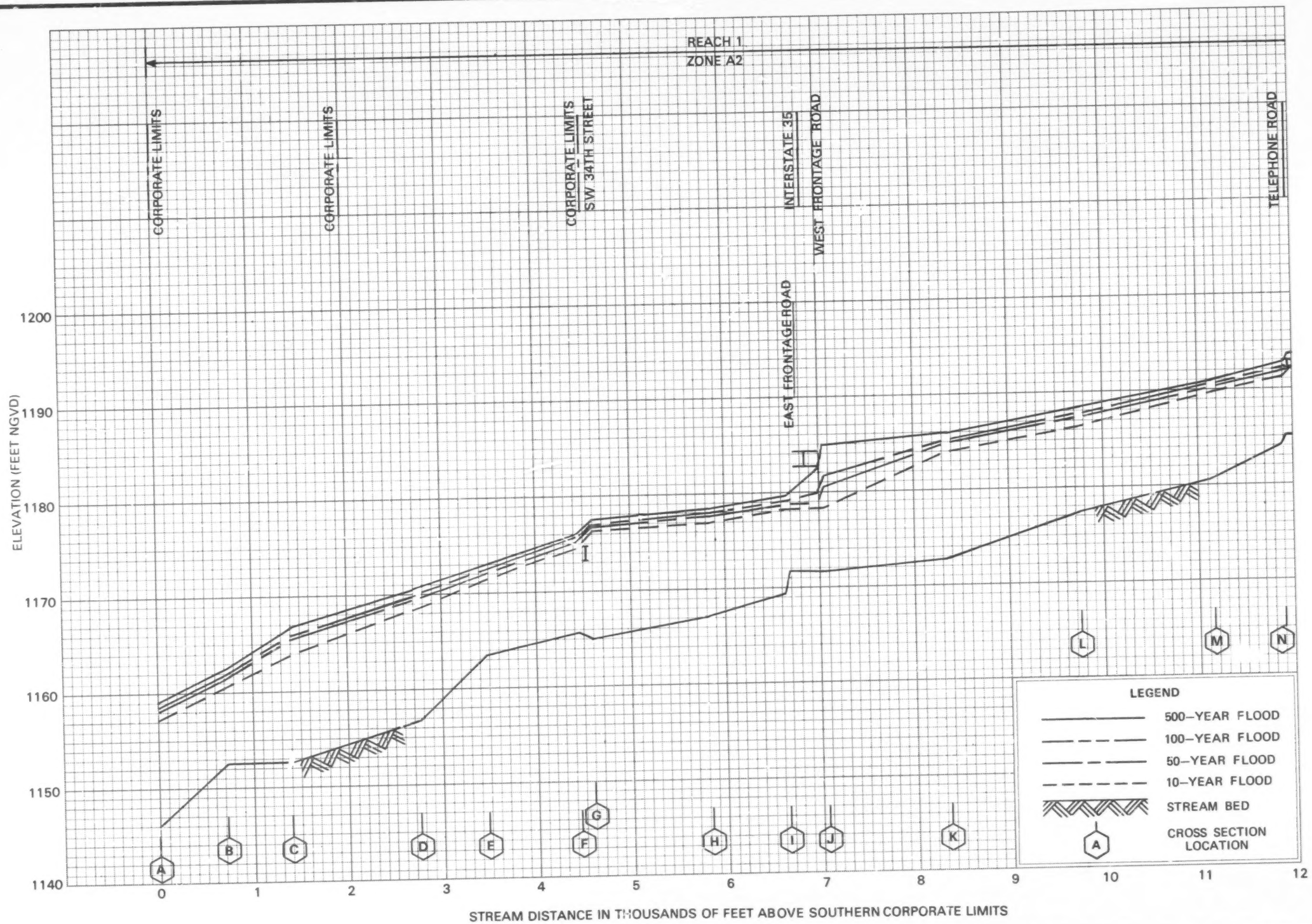


**FLOOD PROFILES**

**LITTLE RIVER**

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(CLEVELAND CO.)

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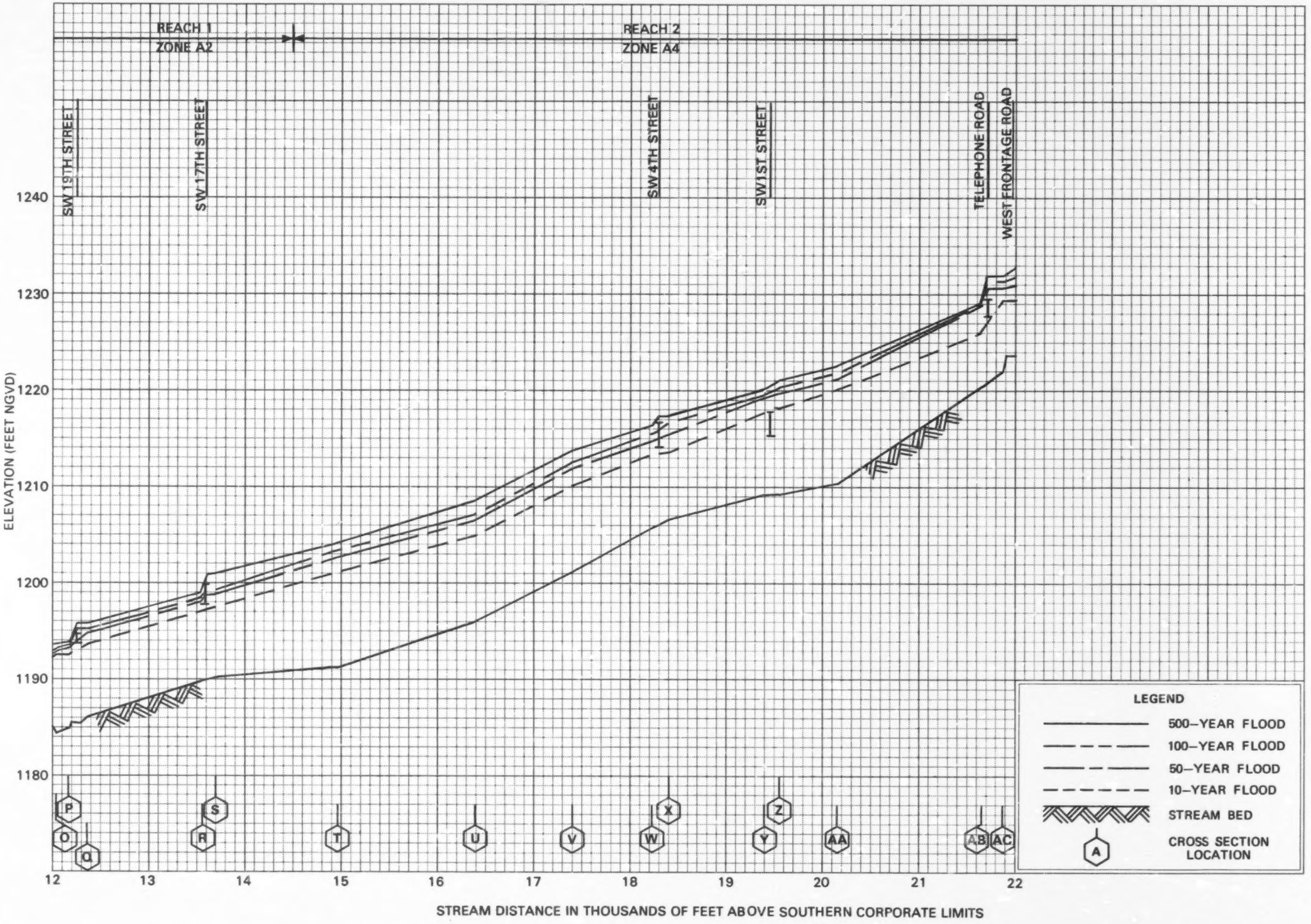


FLOOD PROFILES

LITTLE RIVER

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Federal Insurance Administration

CITY OF MOORE, OK
(CLEVELAND CO.)

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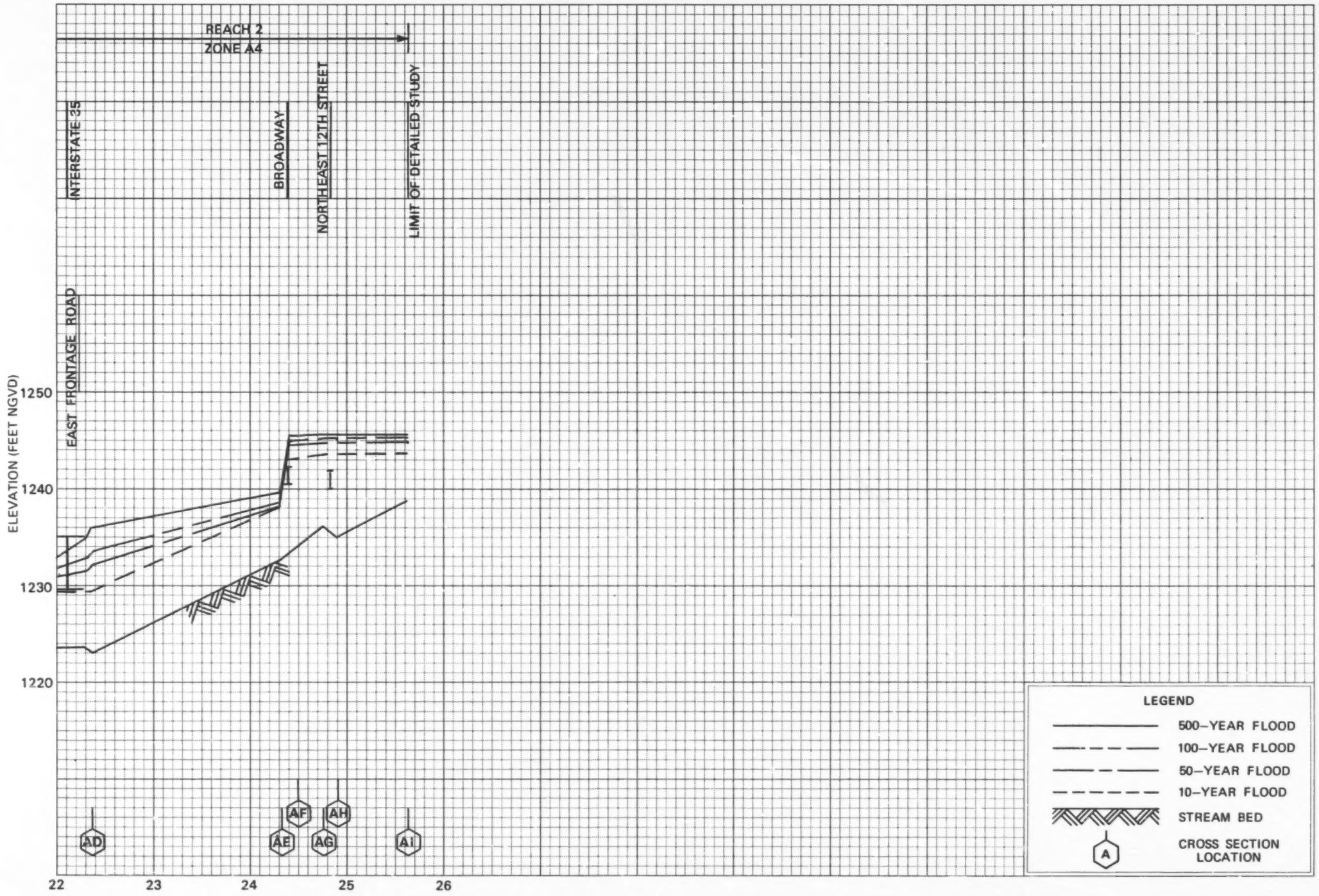


STREAM DISTANCE IN THOUSANDS OF FEET ABOVE SOUTHERN CORPORATE LIMITS

FLOOD PROFILES

LITTLE RIVER

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Federal Insurance Administration

CITY OF MOORE, OK
(CLEVELAND CO.)

14P

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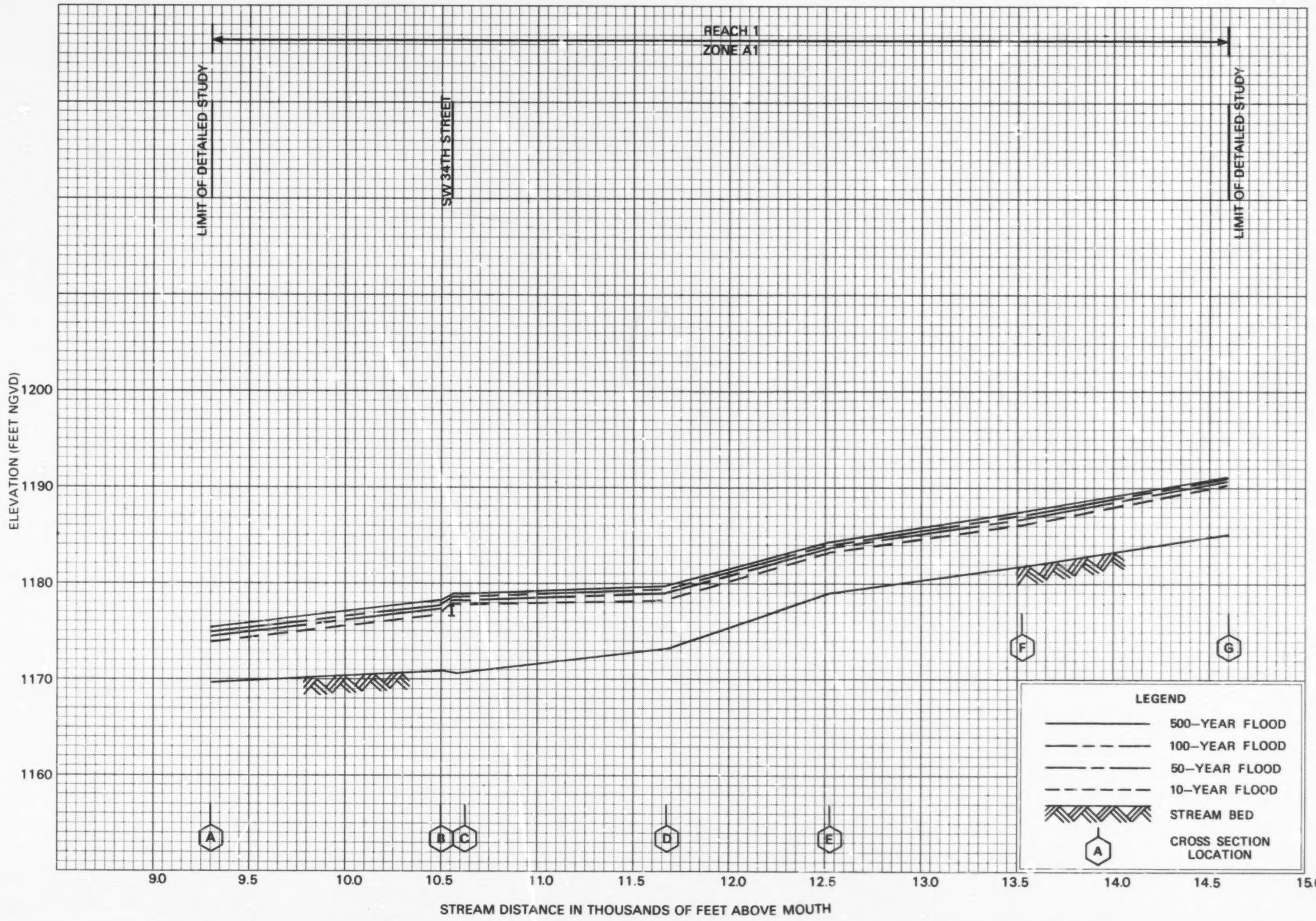


FLOOD PROFILES

STREAM E

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(CLEVELAND CO.)

15P



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